26 July 2019
Revised: August 23, 2019

Duane Martin
Town Engineer
Town of West Hartford
50 South Main Street
West Hartford, CT 06107

RE: Stormwater Management
University of St. Joseph (USJ)
1678 Asylum Avenue
West Hartford, CT
Langan Project No. 140202901

Dear Mr. Martin:

This letter provides an analysis of the existing and proposed peak runoff discharges and the engineering design for the proposed stormwater conveyance system.

PROJECT DESPCRIPTION

Existing Site Conditions

The project site is located at 1678 Asylum Avenue in West Hartford, Connecticut; see Figure 1. The ±82 acre campus consists of university buildings, driveways, parking areas, athletic facilities and open space.

A topographic survey prepared by Langan, shows that grades within the vicinity of the proposed project area vary from about elevation 103 on the east to elevation 130 on the west (NAVD88). There is an existing stormwater collection system on site consisting of catch basins, manholes, yard drains, detention basins and outlet control structures.

Based upon FEMA's Flood Insurance Rate Map (FIRM) Community Panel Number 09003C0361F, effective date September 26, 2008, the project's area is located within Zone X, or areas outside the 100-year flood plain (See Figure 2).

According to the USDA Natural Resources Conservation Service Web Soil Survey, the soil types onsite include Udorthents – Urban land complex, Udorthent, Ludlow Silt Loam, and Brancroft Silt Loam (See Figure 3). These soil types have a hydrological ratings of B and C. There are wetlands on site with the nearest abutting the southeast portion of the project.

Proposed Project

The project includes the construction of a ±24,535 SF addition to the University's O'Connell Athletic Center. The addition will be located directly south of the existing building where there is

an existing impervious parking area. Other proposed improvements include revised parking and drive areas, sidewalks, landscaping, and utilities to serve the proposed addition. Stormwater improvements include a series of catch basins, yard drains, manholes, a swale, and a subsurface detention system. Note, although outside the watershed analysis limits of this report, about 32,000 sf of impervious track surface will be converted to lawn at the conclusion of construction of this project. This will further reduce peak runoff from the overall USJ site.

PEAK RUNOFF ANALYSIS (See Appendix A)

The stormwater management system is designed to control the rate of runoff from the site's watersheds to be equal or less than existing conditions up to, and including, a 100-year design storm event.

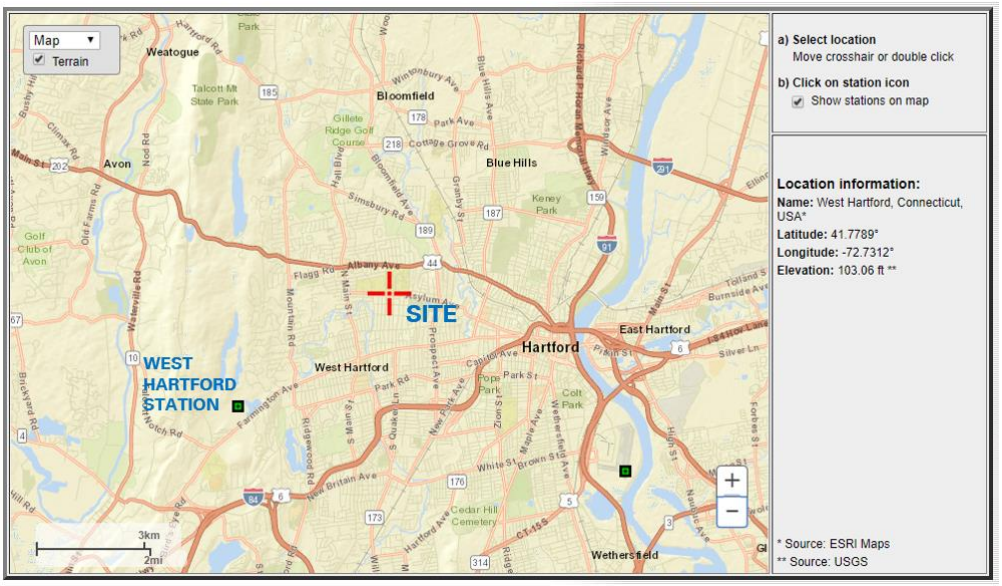
The peak runoff discharges for the existing and proposed conditions were analyzed using Soil Conservation Service (SCS) methodology, which outlines procedures for calculating peak rates of runoff resulting from precipitation events, and procedures for developing runoff hydrographs. Values for area, curve number and time of concentration were calculated for the existing and proposed conditions.

The curve number "CN" is a land-sensitive coefficient that dictates the relationship between total rainfall depth and direct storm runoff. The soils within the watershed are divided into hydrologic soil groups (A, B, C and D). The SCS classification system evaluates the runoff potential of a soil according to its infiltration and transmission rates. "A" soils have the lowest runoff potential, and "D" soils have the greatest runoff potential. Soils within the development area predominantly have a hydrologic soil group designation of "B" and "C."

The time of concentration, Tc, is defined as the time for runoff to travel from the hydraulically most distant point in the watershed to a point of interest. Values of time of concentration were determined for existing and proposed conditions based on land cover and slope of the flow path using methods outlined in TR-55.

For this study, a 24-hour SCS Type III standard rainfall distribution was used to determine the peak flow rates discharging from the site. Precipitation data used for the various storm events is based on the "NOAA Atlas 14 Point Precipitation Frequency Estimates: CT" for West Hartford Station. West Hartford Station was chosen for rainfall data because it is the station located within the closest proximity of the project location as shown in Graphic 1. A summary of all rainfall data utilized in the analysis for this site is provided below and a complete compilation of data provided by NOAA for this location is included in Appendix D.

Graphic 1. NOAA Rainfall Data Location Map



NOAA Precipitation Depth per Average Recurrence Interval [in]						
Duration	**2-Year**	**5-Year**	**10-Year**	**25-Year**	**50-Year**	**100-Year**
24-hour	3.30	4.39	5.30	6.54	7.45	8.46

Existing Condition (See Appendix A)

The existing project area is partially developed with an athletic building. Impervious areas include the building roof, surface parking lot, roadways, and sidewalks. Existing watershed A is comprised of about 1.42 acres and includes the existing building. Watershed A collects water via an existing on-site storm drainage system and flows westerly via an existing 24" pipe on campus. This system continues southwest and discharges into an existing drainage system. Existing Watershed B is about 4.24 acres and collects water from the existing parking area within the project site. Watershed B also collects water from up-gradient sources including a cemetery to the east and drive and lawn areas to the south. Watershed B discharges into the wetlands southwest of the project site via an existing drainage pipe.

Proposed Condition (See Appendix B)

In the proposed condition, site hydrology mimics the existing condition. Proposed Watershed A is reduced to 1.29 acres and continues to flow westerly via an existing 24" pipe on campus.

Proposed Watershed B has been further divided into two sub-watersheds for analysis. Watershed B1 is 1.63 acres and collects water from the proposed building roof as well a portion of the proposed parking area and offsite flow from the east. Watershed B1 is routed through a proposed below grade stormwater system comprised of arch chambers and stone bedding. Watershed B2 is 2.83 acres and collects the majority of runoff from areas outside of the project limits as well as a portion of the proposed parking area. Runoff from Watersheds B1and B2 combine within a proposed on-site manhole prior to connecting back into the existing on site drainage system that discharges to the wetlands.

The proposed arch chamber system will be installed on a crushed-stone bed and set to encourage groundwater recharge. Percolation testing has not been completed on-site at the time of this report and no field data indicating soil infiltration capabilities is readily available at this time. Therefore, this system was analyzed without accounting for infiltration and any infiltration realized at the time of construction will be an added benefit. The proposed oversized storage pipe has been designed as a detention facility with no potential for infiltration.

Two stormwater quality units are proposed in catch basin locations that collect runoff from the proposed parking and drive areas. Per the 2004 Connecticut Stormwater Quality Manual, these hydrodynamic separators have been design to treat the water quality flow produced by 1" of rainfall. They capture and retain floatables while removing sediment from stormwater runoff. In addition, sumps are provided within each catch basin to further collect sediment.

Site Discharge Peak Flow Comparison for WS-A (CFS)

	Current	Proposed	Delta
2- Year	2.4	2.3	-0.1
5-Year	3.6	3.4	-0.2
10-Year	4.5	4.3	-0.2
25-Year	5.9	5.5	-0.3
50-Year	6.8	6.4	-0.4
100-Year	7.9	7.4	-0.5

Site Discharge Peak Flow Comparison for WS-B (CFS)

	Current	Proposed	Delta
2- Year	3.1	3.0	-0.1
5-Year	5.6	5.6	0.0
10-Year	7.8	7.8	0.0
25-Year	11.0	10.9	-0.1
50-Year	13.5	13.1	-0.4
100-Year	16.2	16.2	0.0

Site Discharge Peak Flow Comparison for TOTAL SITE (CFS)*

	Current	Proposed	Delta
2- Year	5.2	4.8	-0.4
5-Year	8.7	8.4	-0.3
10-Year	11.9	11.4	-0.5
25-Year	16.3	15.7	-0.7
50-Year	19.7	18.7	-0.9
100-Year	23.4	22.2	-1.2

* Note, although outside the watershed analysis limits of this report, about 32,000 sf of impervious track surface will be converted to lawn at the conclusion of construction of this project. This will further reduce peak runoff from the overall USJ site.

STORMWATER CONVEYANCE SYSTEM (See Appendix B)

The stormwater conveyance system was sized using the Rational Method for the 10-year storm event. Values for area, runoff coefficient, C, and a time of concentration were calculated for each drainage area, see Figure DACB. The average runoff coefficient was calculated based upon the following cover types:

Cover	C
Grass/Pervious	0.3
Gravel	0.6
Roof/Pavement/Impervious	0.9

Rainfall intensities were taken from the "NOAA Atlas 14 Point Precipitation Frequency Estimates: CT" for West Hartford Station. Stormwater pipes were then sized based upon the Manning's Equation for full flow pipe capacity and solving for the hydraulic grade line. The computer program Hydraflow Storm Sewers 2011 by Intellisolve was used in the analysis.

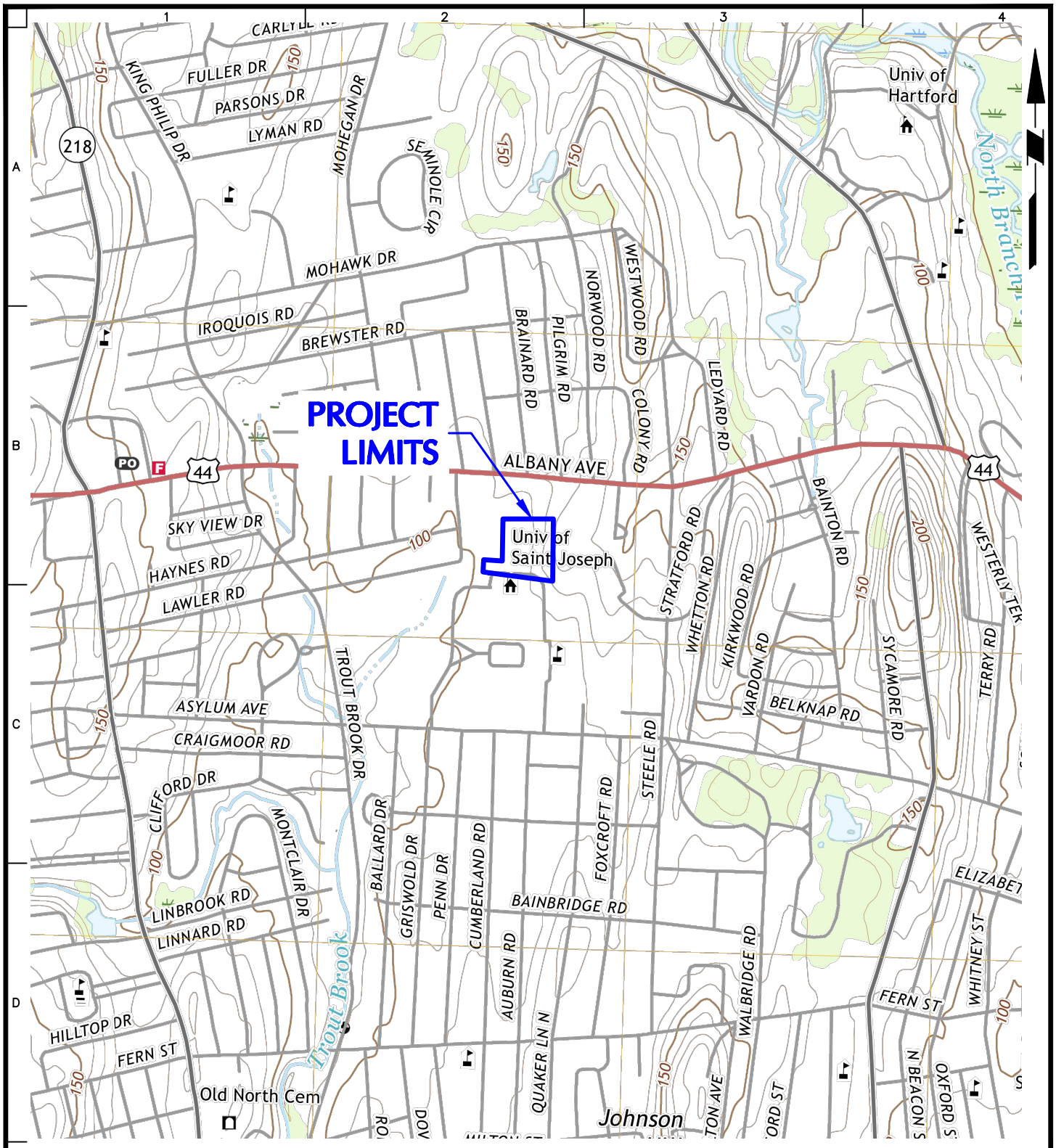
Each proposed storm sewer system has been analyzed using a starting HGL elevation equal to the outlet pipe's crown elevation. This mimics a tailwater elevation equal to the outlet pipe's diameter or a scenario where a proposed pipe is entering an existing pipe flowing at full capacity.

Please refer to the Drawings for additional drainage information.

LIST OF FIGURES

LIST OF DRAWINGS

LIST OF APPENDICES



REFERENCE: "HARTFORD NORTH QUADRANGLE" HARTFORD COUNTY, CONNECTICUT, U.S. DEPARTMENT OF THE INTERIOR, U.S. GEOLOGICAL SURVEY, DATED 2018.

1500 0 500 1500

SCALE: 1 INCH = 1500 FEET

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Project	USJ O'CONNELL CENTER
	WEST HARTFORD CONNECTICUT
Drawing Title	USGS SITE LOCATION MAP
Project No.	140202901
Date	07/26/2019
Drawn By	AMC
Checked By	CPC
Drawing No.	FIG 01
Sheet	1 of 4

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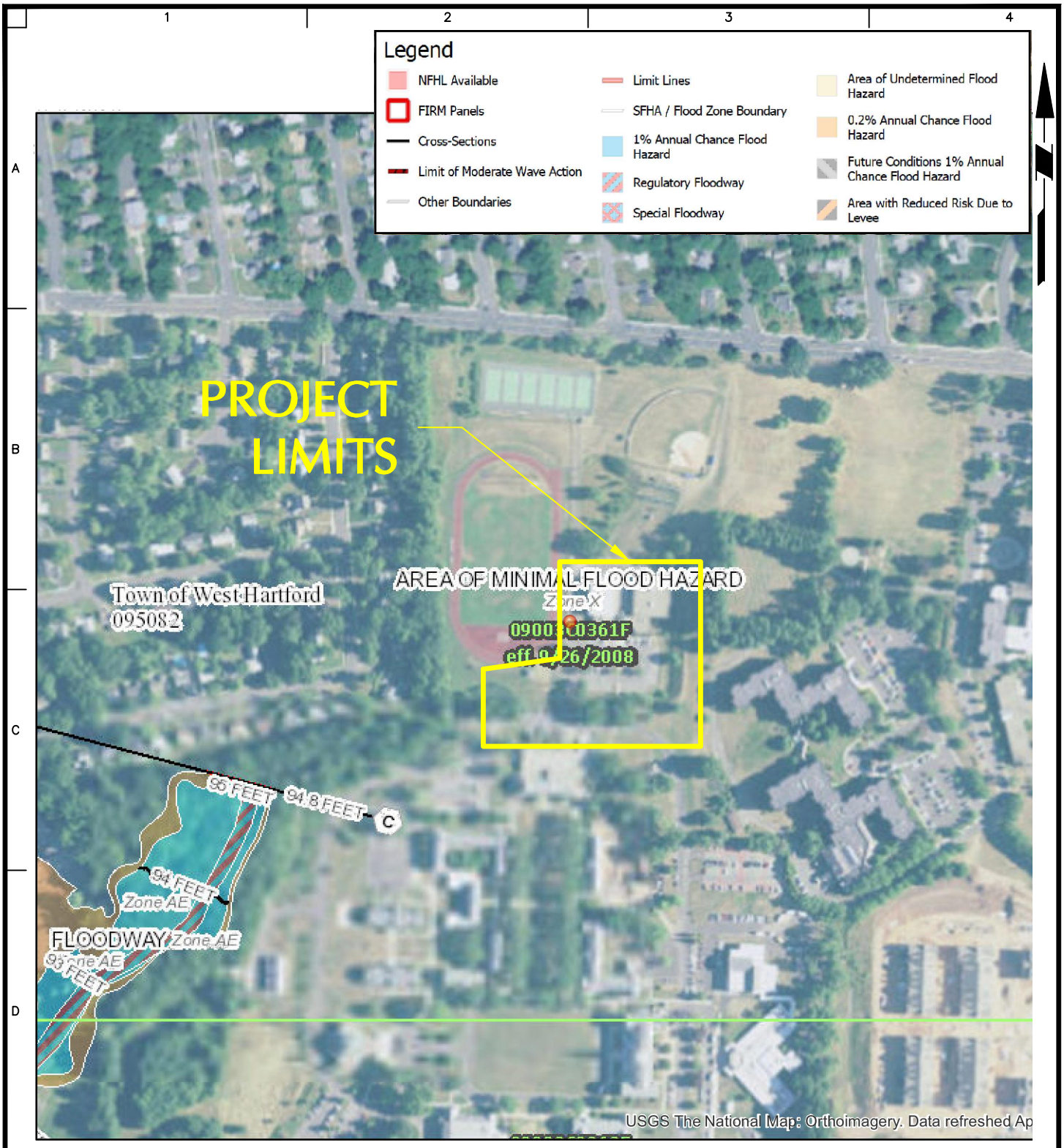

REFERENCE: "FLOOD INSURANCE RATE MAP" WEST HARTFORD COUNTY, CONNECTICUT, FEMA MAP NUMBERS 09003C0361F REVISED TO SEPTEMBER 26, 2008.

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SCALE: 1 INCH = 500 FEET

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Project	USJ O'CONNELL CENTER
	WEST HARTFORD CONNECTICUT
Drawing Title	EFFECTIVE FEMA FIRM
Project No.	140202901
Date	07/26/2019
Drawn By	AMC
Checked By	CPC
Drawing No.	FIG 02
Sheet	2 of 4

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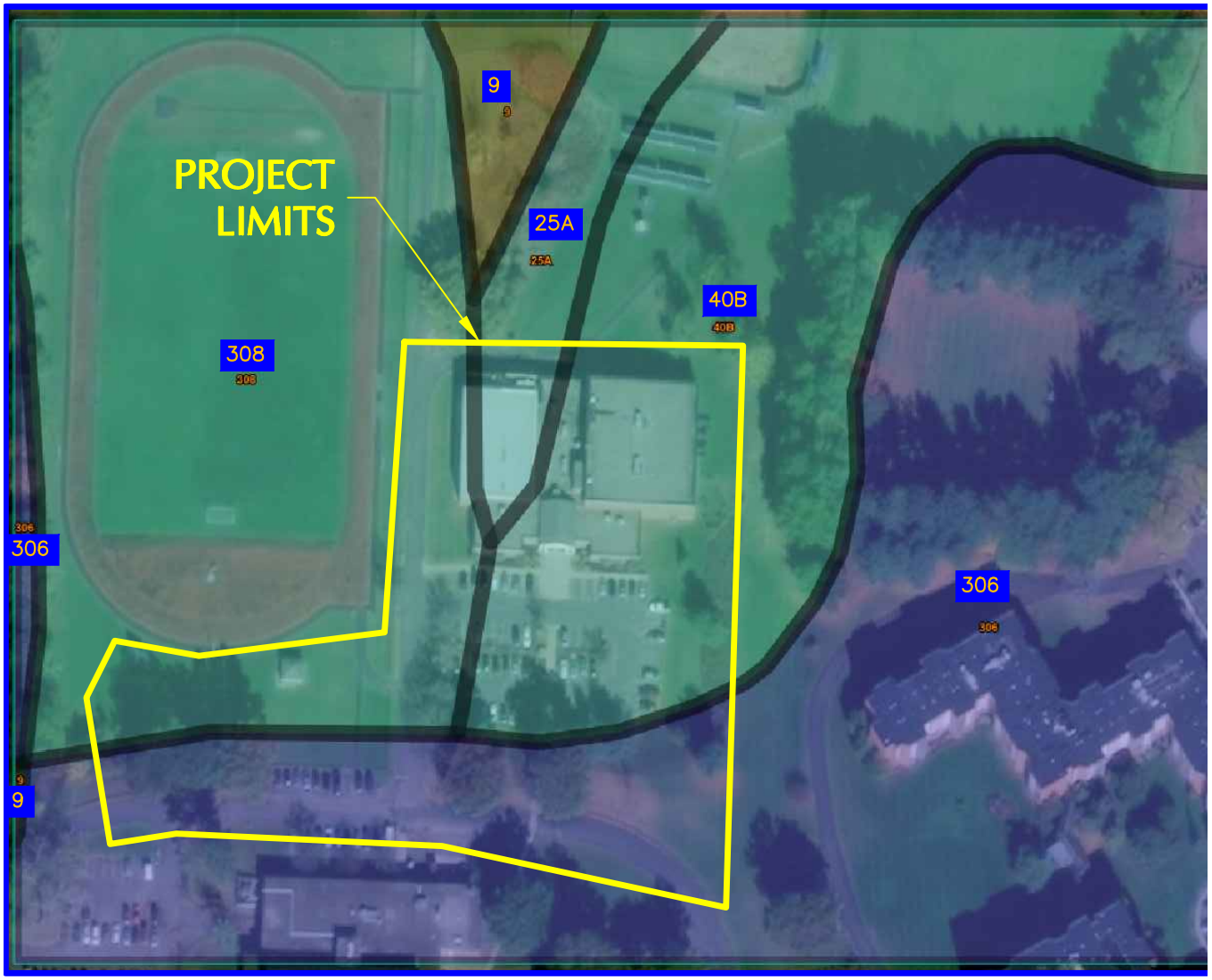

SOIL LEGEND

ID	TYPE	RATING
306	UDORTHENTS–URBAN LAND COMPLEX	B
308	UDORTHENT, SMOOTHED	C
40B	LUDLOW SILT LOAM	C
25A	BRANCROFT SILT LOAM	C
9	SCITICO, SHAKER, ANDMAYBID SOILS	C/D

REFERENCE: WEB SOIL SURVEY BY UNITED STATES DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE.

150 0 100 150

SCALE: 1 INCH = 150 FEET

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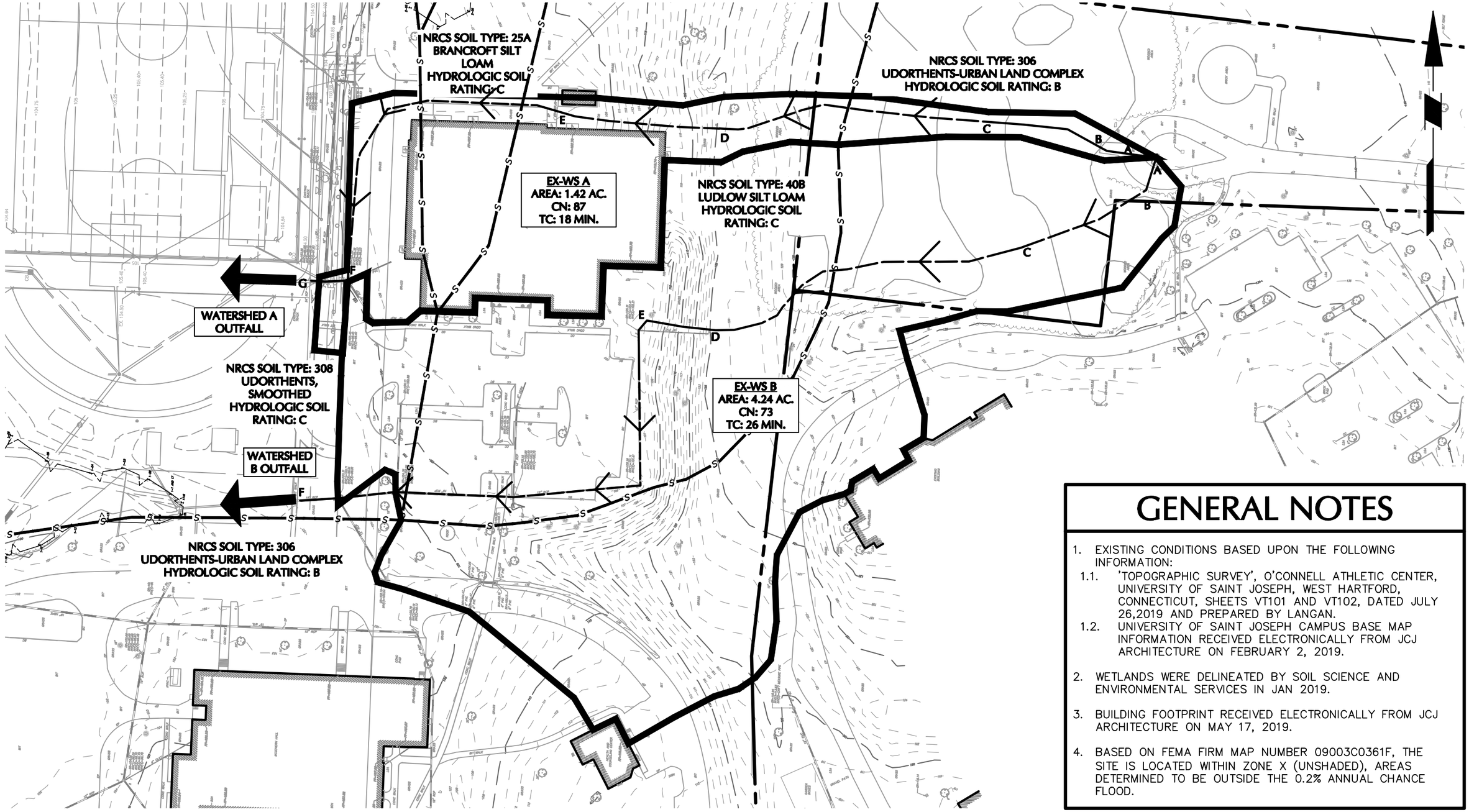
Project: USJ O'CONNELL CENTER
WEST HARTFORD CONNECTICUT

Drawing Title: NRCS SOIL MAP

Project No. 140202901
Date 07/26/2019
Drawn By AMC
Checked By CPC

Drawing No. FIG 03
Sheet 3 of 4

Filename: \\langan.com\data\NHV\data9\140202901\Project Data\CAD\01\SheetFiles\Civil\figures\FG03-140202901-NRCS.dwg Date: 7/15/2019 Time: 15:49 User: kkromish Style Table: Langan.stb Layout: FIG 3



GENERAL NOTES

1. EXISTING CONDITIONS BASED UPON THE FOLLOWING INFORMATION:
   - 1.1. 'TOPOGRAPHIC SURVEY', O'CONNELL ATHLETIC CENTER, UNIVERSITY OF SAINT JOSEPH, WEST HARTFORD, CONNECTICUT, SHEETS VT101 AND VT102, DATED JULY 26,2019 AND PREPARED BY LANGAN.
   - 1.2. UNIVERSITY OF SAINT JOSEPH CAMPUS BASE MAP INFORMATION RECEIVED ELECTRONICALLY FROM JCJ ARCHITECTURE ON FEBRUARY 2, 2019.
2. WETLANDS WERE DELINEATED BY SOIL SCIENCE AND ENVIRONMENTAL SERVICES IN JAN 2019.
3. BUILDING FOOTPRINT RECEIVED ELECTRONICALLY FROM JCJ ARCHITECTURE ON MAY 17, 2019.
4. BASED ON FEMA FIRM MAP NUMBER 09003C0361F, THE SITE IS LOCATED WITHIN ZONE X (UNSHADED), AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOOD.

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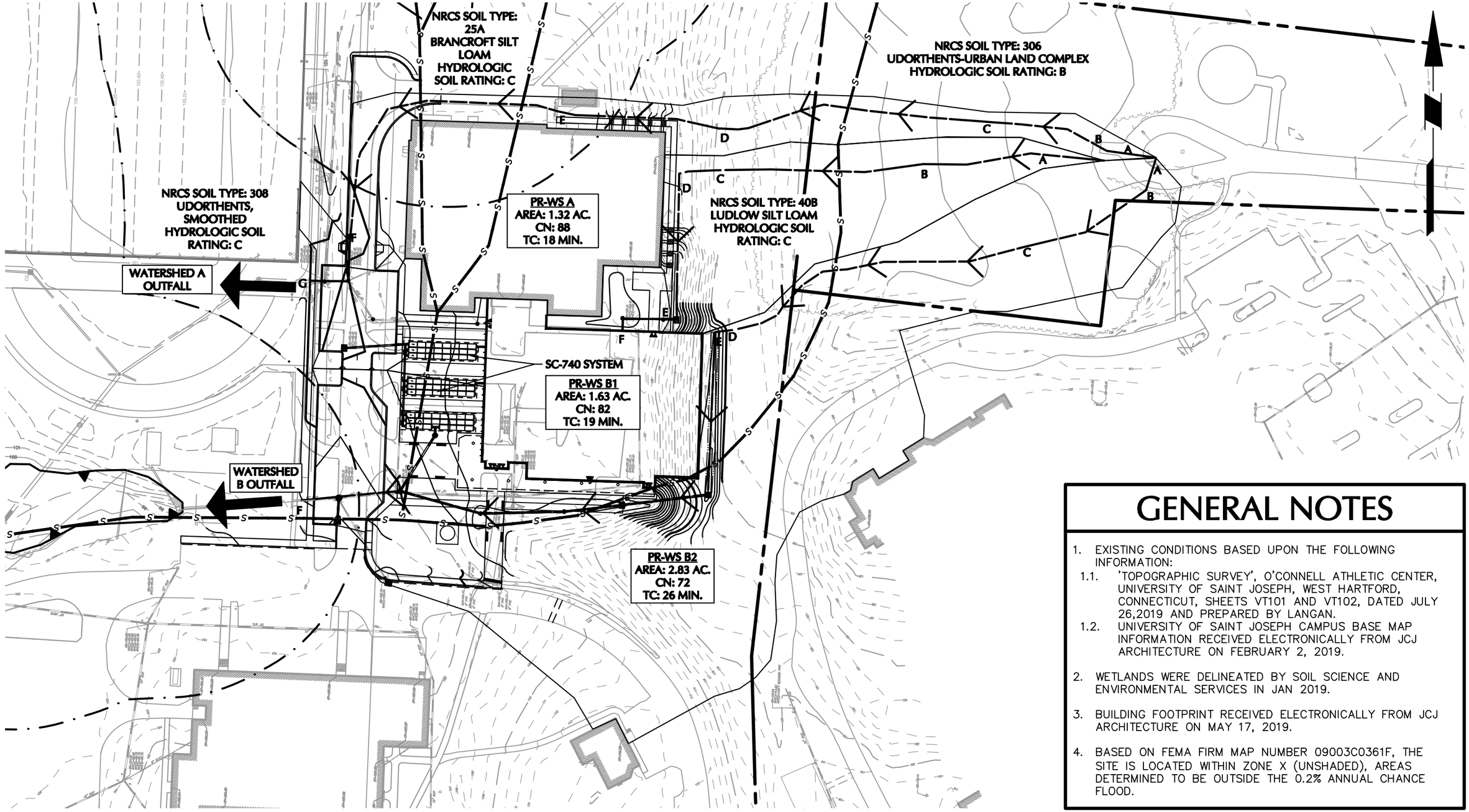
Project
O'CONNELL ATHLETIC CENTER ADDITION
WEST HARTFORD
HARTFORD COUNTY CONNECTICUT

Drawing Title
EXISTING WATERSHED MAP

Project No.	140202901
Date	JULY 26, 2019
Drawn By	KMS
Checked By	KEG

Drawing No.
EXWS
Sheet 1 of 3

Filename: \\langan.com\data\NHV\data9\140202901\Project Data\CAD\01\SheetFiles\Stormwater\140202901-CG103-0101.dwg Date: 8/23/2019 Time: 11:25 User: kstublic Style Table: Langan.stb Layout: EXWS



GENERAL NOTES

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   1.1. 'TOPOGRAPHIC SURVEY', O'CONNELL ATHLETIC CENTER, UNIVERSITY OF SAINT JOSEPH, WEST HARTFORD, CONNECTICUT, SHEETS VT101 AND VT102, DATED JULY 26,2019 AND PREPARED BY LANGAN.
   1.2. UNIVERSITY OF SAINT JOSEPH CAMPUS BASE MAP INFORMATION RECEIVED ELECTRONICALLY FROM JCJ ARCHITECTURE ON FEBRUARY 2, 2019.
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4. BASED ON FEMA FIRM MAP NUMBER 09003C0361F, THE SITE IS LOCATED WITHIN ZONE X (UNSHADED), AREAS DETERMINED TO BE OUTSIDE THE 0.2% ANNUAL CHANCE FLOOD.

80 0 40 80

SCALE: 1 INCH = 80 FEET

REVISION DATE: AUGUST 23, 2019

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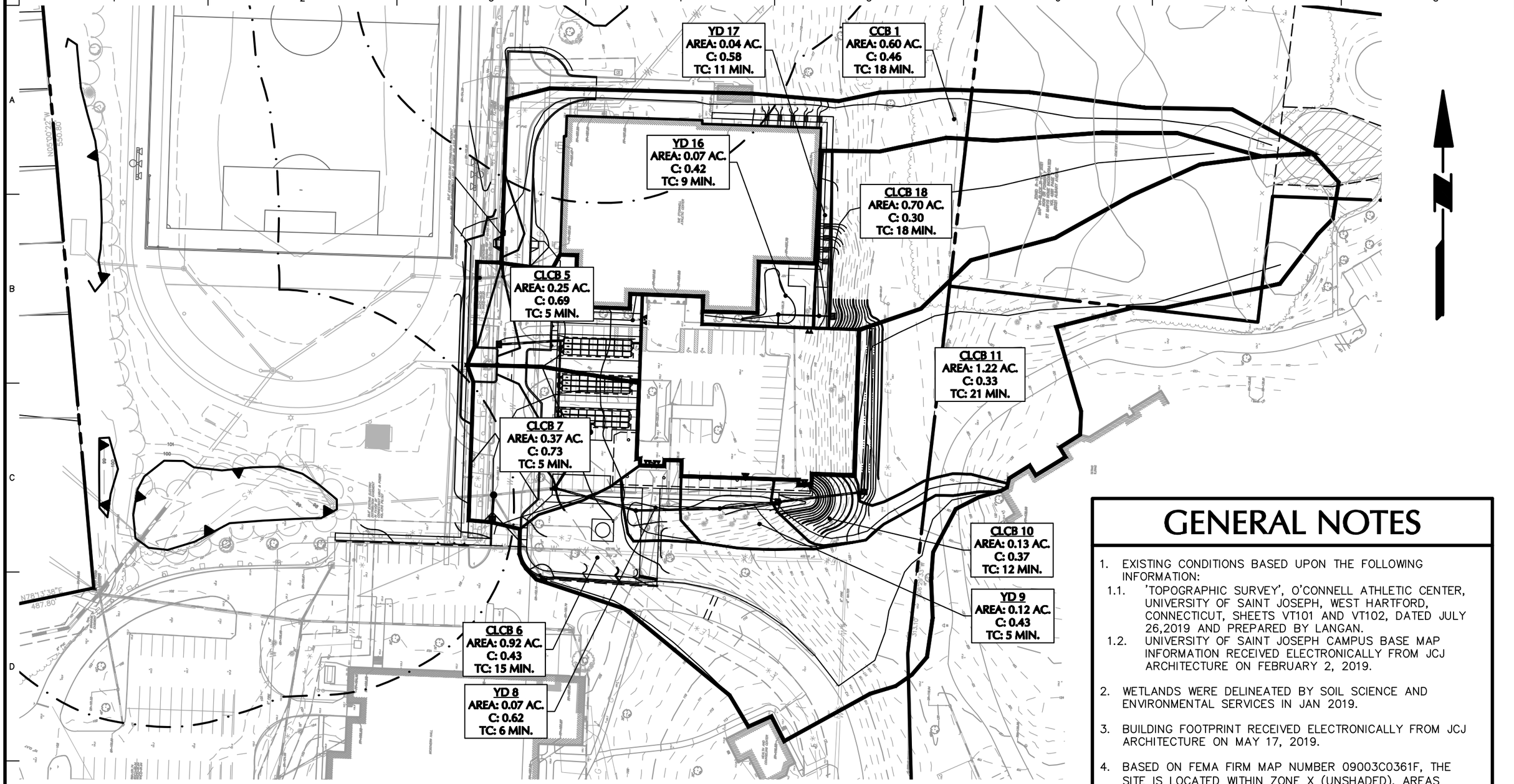
Project
O'CONNELL ATHLETIC CENTER ADDITION
WEST HARTFORD
HARTFORD COUNTY CONNECTICUT

Drawing Title
PROPOSED WATERSHED MAP

Project No. 140202901	Drawing No. PRWS
Date JULY 26, 2019	
Drawn By KMS	
Checked By KEG	Sheet 2 of 3

Filename: \\langan.com\data\NHV\data9\140202901\Project Data\CAD\01\SheetFiles\Stormwater\140202901-CG104-0101.dwg Date: 8/23/2019 Time: 11:31 User: kstublic Style Table: Langan.stb Layout: PRWS



GENERAL NOTES

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   - 1.1. 'TOPOGRAPHIC SURVEY', O'CONNELL ATHLETIC CENTER, UNIVERSITY OF SAINT JOSEPH, WEST HARTFORD, CONNECTICUT, SHEETS VT101 AND VT102, DATED JULY 26,2019 AND PREPARED BY LANGAN.
   - 1.2. UNIVERSITY OF SAINT JOSEPH CAMPUS BASE MAP INFORMATION RECEIVED ELECTRONICALLY FROM JCJ ARCHITECTURE ON FEBRUARY 2, 2019.
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80 0 40 80

SCALE: 1 INCH = 80 FEET

REVISION DATE: AUGUST 23, 2019

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Project
O'CONNELL ATHLETIC CENTER ADDITION
WEST HARTFORD
HARTFORD COUNTY CONNECTICUT

Drawing Title
DRAINAGE AREA CATCHMENT MAP

Project No.	140202901
Date	JULY 26, 2019
Drawn By	AG
Checked By	KEG

Drawing No. DACB

Sheet 3 of 3

Filename: \\langan.com\data\NHV\data9\140202901\Project Data\CAD\01\SheetFiles\Stormwater\140202901-CG104-0102.dwg Date: 8/23/2019 Time: 11:46 User: kstublic Style Table: Langan.stb Layout: DACB

APPENDIX A

Existing Stormwater Discharge Calculations

Project **USJ O'CONNELL ATHLETIC CENTER** By **KMS** Date **7/26/2019**

Location **WEST HARTFORD, CT** Checked **KEG** Date **7/26/2019**

Circle one: (Present) Developed **EX-WS A**

1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1] Table 2-2	CN [1] Fig. 2-3	CN [1] Fig. 2-4	Area [x] acres [ ] mi² [ ] %	Product of CN x area
C	**Impervious**	**98**			**0.88**	**86.06**
C	**Open Space, Good Cond.**	**74**			**0.32**	**23.39**
C	**Woods, Good Condition**	**70**			**0.07**	**5.05**
B	**Open Space, Good Cond.**	**61**			**0.15**	**9.08**
1 Use only one CN source per line				Totals =	**1.42**	**123.59**

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{123.59}{1.42} =$ 87.32 Use CN = **87**

2. Runoff

		Storm 1	Storm 2	Storm 3
Frequency	yr			
Rainfall, P (24-hour)	in			
S				
Runoff, Q	in			

(Use P and CN with Table 2-1, Fig. 2-1,

Project **USJ O'CONNELL ATHLETIC CENTER** By **KMS** Date **7/26/2019**

Location **WEST HARTFORD, CT** Checked **KEG** Date **7/26/2019**

Circle one: (Present) Developed **EX-WS B**

1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1] Table 2-2	CN [1] Fig. 2-3	CN [1] Fig. 2-4	Area [x] acres [ ] mi^2 [ ] %	Product of CN x area
C	**Impervious**	**98**			**1.00**	**98.19**
C	**Open Space, Good Cond.**	**74**			**0.93**	**68.95**
C	**Woods, Good Condition**	**70**			**0.22**	**15.42**
B	**Open Space, Good Cond.**	**61**			**1.69**	**103.27**
B	**Woods, Good Condition**	**55**			**0.39**	**21.55**
1 Use only one CN source per line				Totals =	**4.24**	**307.37**

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{307.37}{4.24} =$ 72.52 Use CN = **73**

2. Runoff

		Storm 1	Storm 2	Storm 3
Frequency	yr			
Rainfall, P (24-hour)	in			
S				
Runoff, Q	in			

(Use P and CN with Table 2-1, Fig. 2-1,

Project **O'Connell Athletic Center Expansion** By **KMS** Date **7/26/2019**

Location **West Hartford, CT** Checked **KEG** Date **7/26/2019**

Circle One: (Present) Developed

Circle One: (T_c) T_t through subarea **EX-WS A**

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c Only)		Segment ID	AB	BC				
1. Surface description (table 3-1)			Smooth Surface	Dense Grasses				
2. Manning's roughness coeff., n (table 3-1)			0.01	0.24				
3. Flow Length, L (total L ≤ 300 ft)		ft	40	110				
4. Two-yr 24-hr rainfall, P_2		in	3.3	3.3				
5. Land slope, s		ft/ft	0.020	0.025				
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t	hr	0.010	+ 0.231	+	=	0.241	

Shallow concentrated flow		Segment ID	CD	DE	EF			
7. Surface description (paved or unpaved)			Unpaved	Unpaved	Paved			
8. Flow length, L		ft	230	140	300			
9. Watercourse slope, s		ft/ft	0.030	0.300	0.020			
10. Average velocity, V (figure 3-1)		ft/s	2.8	8.8	2.9			
11. $T_t = \frac{L}{3600\ V}$	Compute T_t	hr	0.023	+ 0.004	+ 0.029	=	0.056	

Channel flow		Segment ID	FG					
12. Cross sectional flow area, a		ft^2						
13. Wetted perimeter, p_w		ft						
14. Hydraulic radius, r $r = \frac{a}{p_w}$	Compute r	ft						
15. Channel slope, s		ft/ft						
16. Manning's roughness coeff., n								
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Compute V	ft/s	5.00					
18. Flow length, L		ft	30					
19. $T_t = \frac{L}{3600\ V}$	Compute T_t	hr	0.002	+	=	0.002		

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) 0.299 hr

Use Tc= 18 min

Project **O'Connell Athletic Center Expansion** By **KMS** Date **7/26/2019**

Location **West Hartford, CT** Checked **KEG** Date **7/26/2019**

Circle One: (Present) Developed

Circle One: (T_c) T_t through subarea **EX-WS B**

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

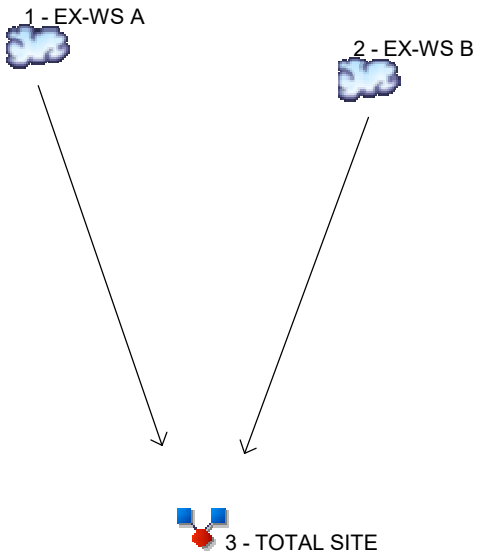
Sheet flow (Applicable to T_c Only)		Segment ID	AB	BC			
1. Surface description (table 3-1)			Smooth Surface	Light Underbrush			
2. Manning's roughness coeff., n (table 3-1)			0.01	0.40			
3. Flow Length, L (total L ≤ 300 ft)		ft	30	120			
4. Two-yr 24-hr rainfall, P_2		in	3.3	3.3			
5. Land slope, s		ft/ft	0.020	0.025			
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t	hr	0.008	+ 0.373	+	=	0.381

Shallow concentrated flow		Segment ID	CD	DE			
7. Surface description (paved or unpaved)			Unpaved	Unpaved			
8. Flow length, L		ft	285	65			
9. Watercourse slope, s		ft/ft	0.030	0.300			
10. Average velocity, V (figure 3-1)		ft/s	2.8	8.8			
11. $T_t = \frac{L}{3600\ V}$	Compute T_t	hr	0.028	+ 0.002		=	0.030

Channel flow		Segment ID	EF				
12. Cross sectional flow area, a		ft^2					
13. Wetted perimeter, p_w		ft					
14. Hydraulic radius, r $r = \frac{a}{p_w}$	Compute r	ft					
15. Channel slope, s		ft/ft					
16. Manning's roughness coeff., n							
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Compute V	ft/s	5.00				
18. Flow length, L		ft	420				
19. $T_t = \frac{L}{3600\ V}$	Compute T_t	hr	0.023	+		=	0.023
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)							0.434 hr

Use Tc= 26 min

Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

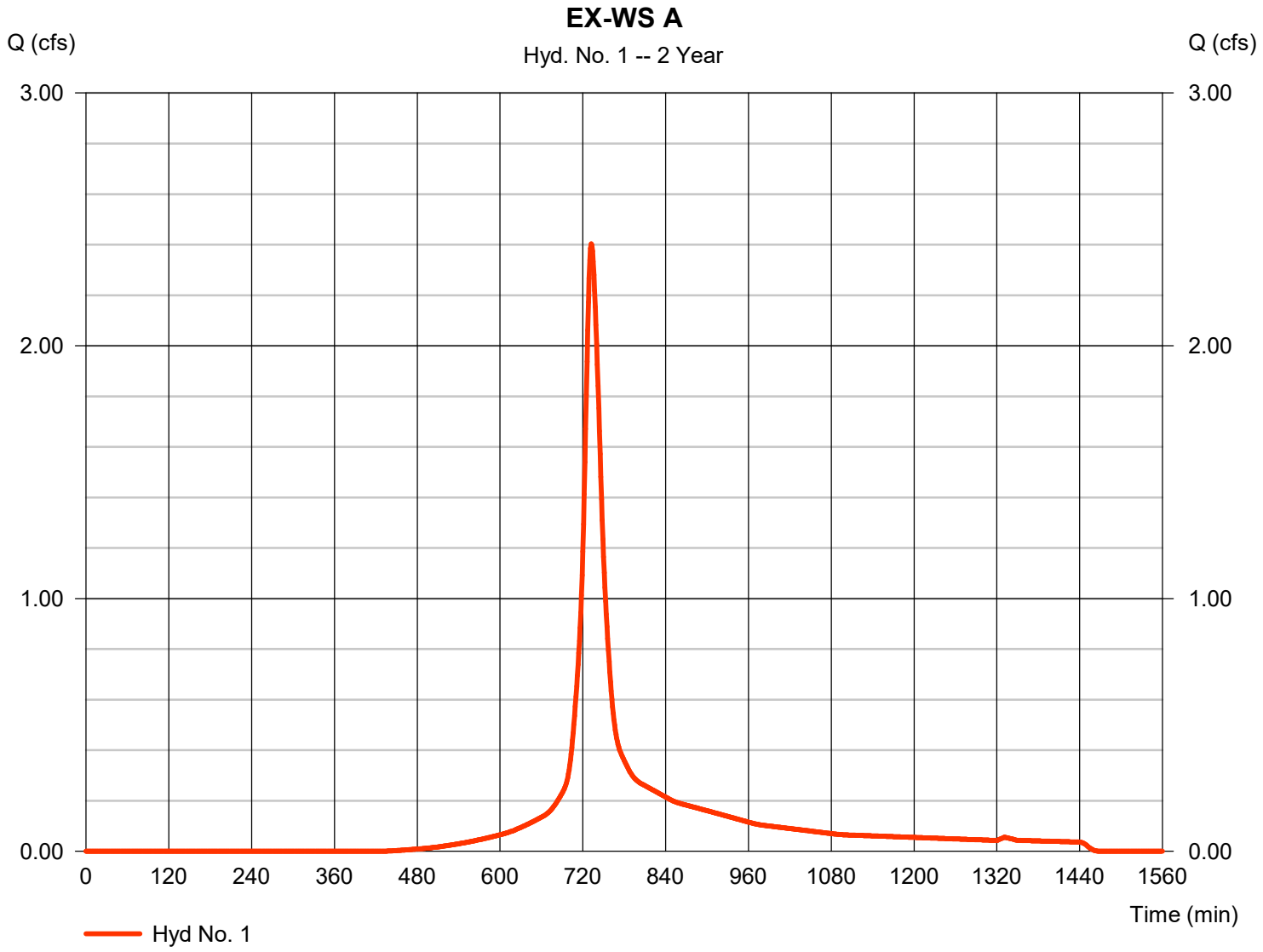
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.404	1	732	10,210	------	------	------	EX-WS A
2	SCS Runoff	3.066	1	741	16,245	------	------	------	EX-WS B
3	Combine	5.200	1	737	26,456	1, 2	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

EX-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.404 cfs
Storm frequency	=	2 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	10,210 cuft
Drainage area	=	1.420 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	3.30 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

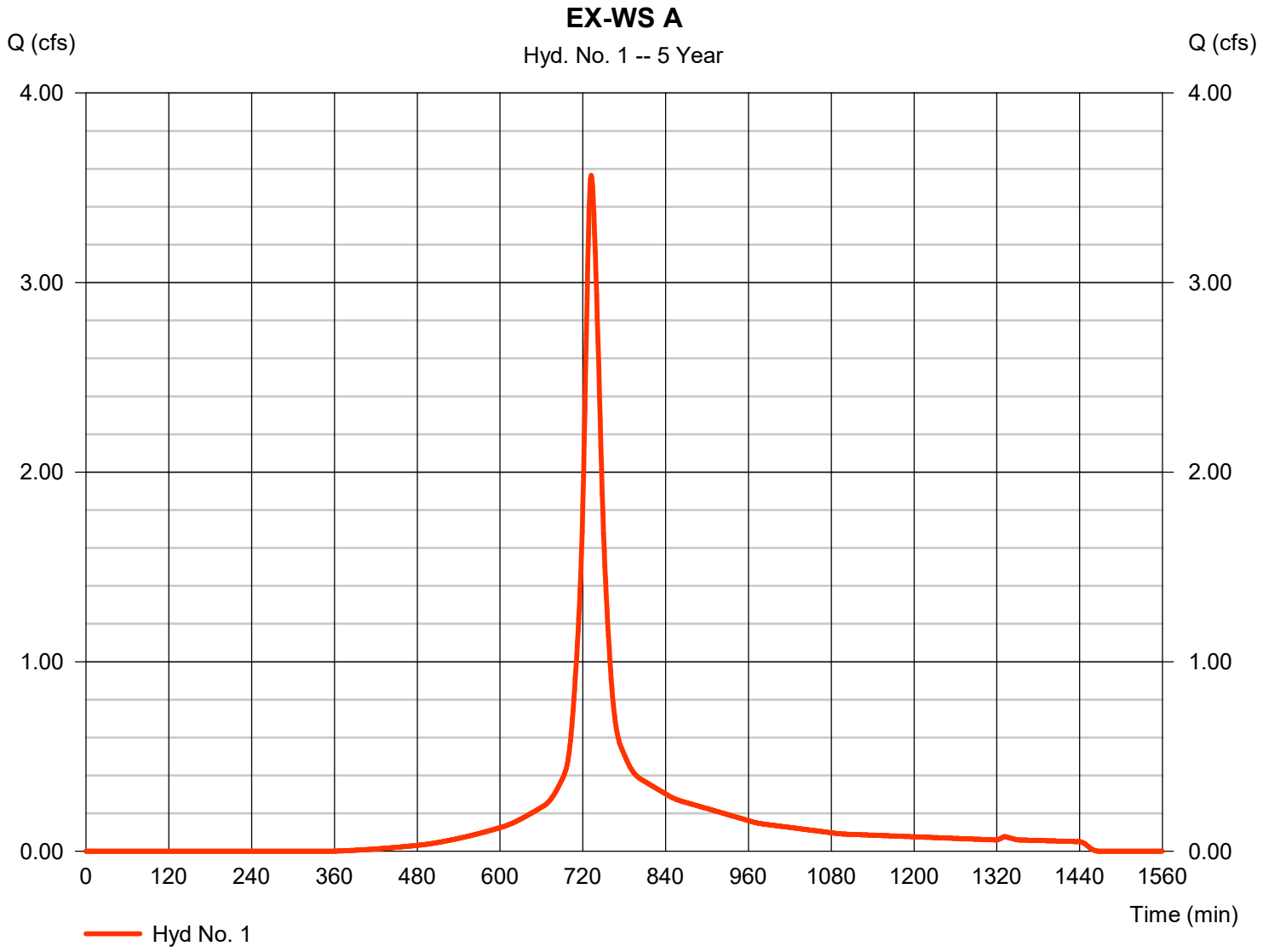
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	3.566	1	732	15,271	------	------	------	EX-WS A
2	SCS Runoff	5.534	1	739	28,124	------	------	------	EX-WS B
3	Combine	8.730	1	736	43,395	1, 2	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

EX-WS A

Hydrograph type	= SCS Runoff	Peak discharge	= 3.566 cfs
Storm frequency	= 5 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 15,271 cuft
Drainage area	= 1.420 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.00 min
Total precip.	= 4.39 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

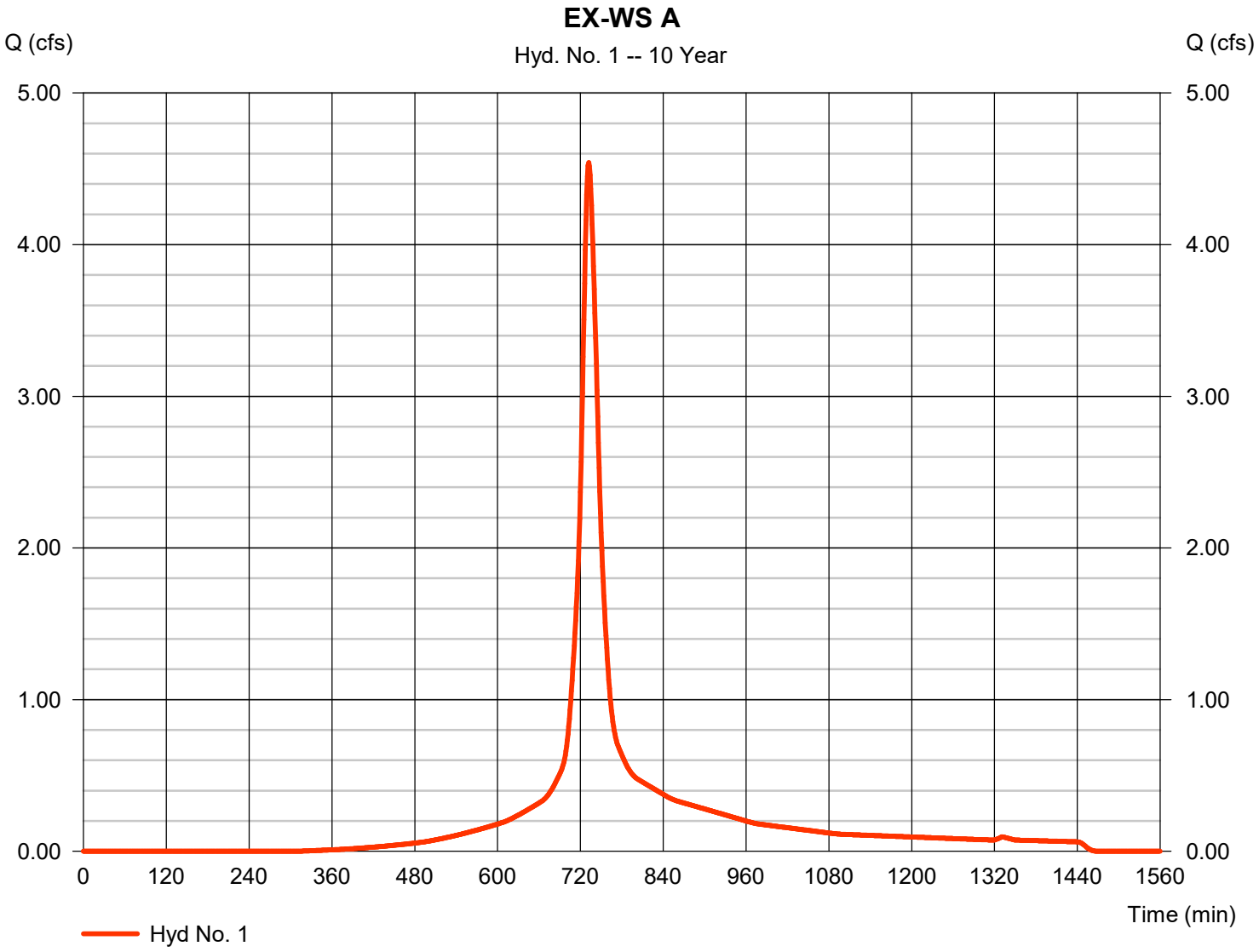
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.541	1	732	19,623	------	------	------	EX-WS A
2	SCS Runoff	7.789	1	739	39,058	------	------	------	EX-WS B
3	Combine	11.88	1	736	58,681	1, 2	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

EX-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.541 cfs
Storm frequency	=	10 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	19,623 cuft
Drainage area	=	1.420 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	5.30 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

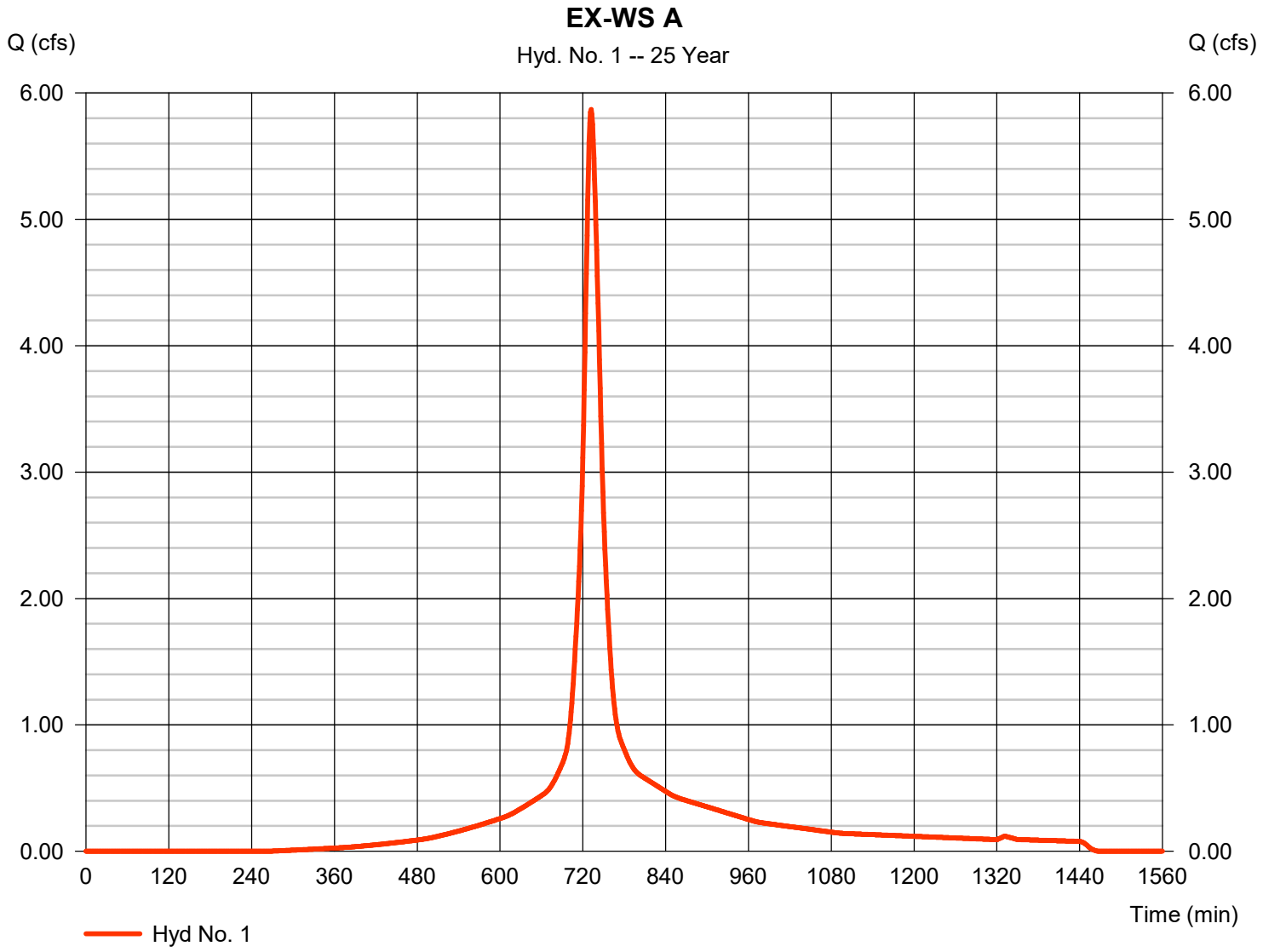
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	5.869	1	732	25,661	------	------	------	EX-WS A
2	SCS Runoff	11.02	1	738	54,938	------	------	------	EX-WS B
3	Combine	16.32	1	736	80,600	1, 2	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

EX-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.869 cfs
Storm frequency	=	25 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	25,661 cuft
Drainage area	=	1.420 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	6.54 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

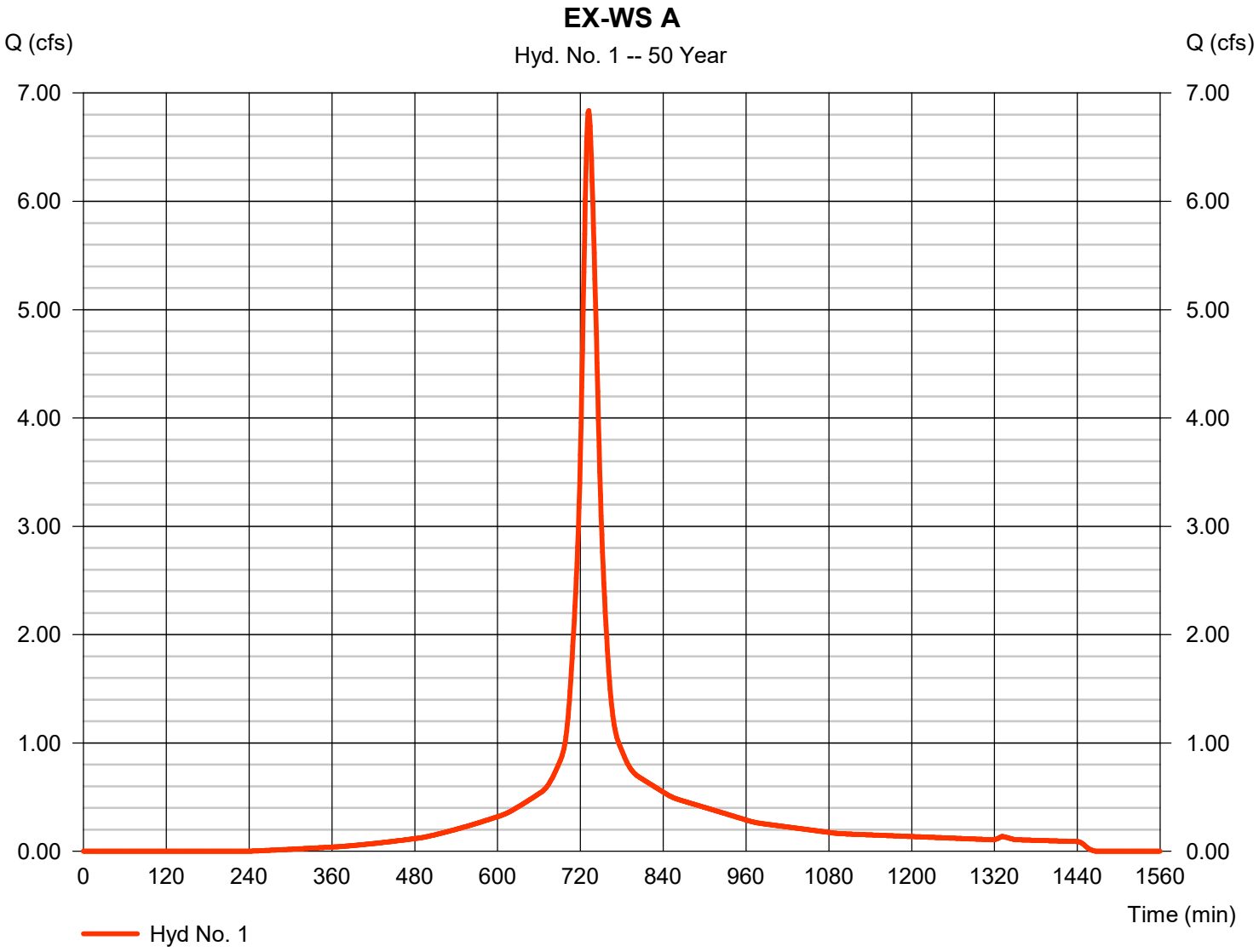
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	6.839	1	732	30,144	------	------	------	EX-WS A
2	SCS Runoff	13.47	1	738	67,101	------	------	------	EX-WS B
3	Combine	19.66	1	736	97,245	1, 2	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

EX-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.839 cfs
Storm frequency	=	50 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	30,144 cuft
Drainage area	=	1.420 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	7.45 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

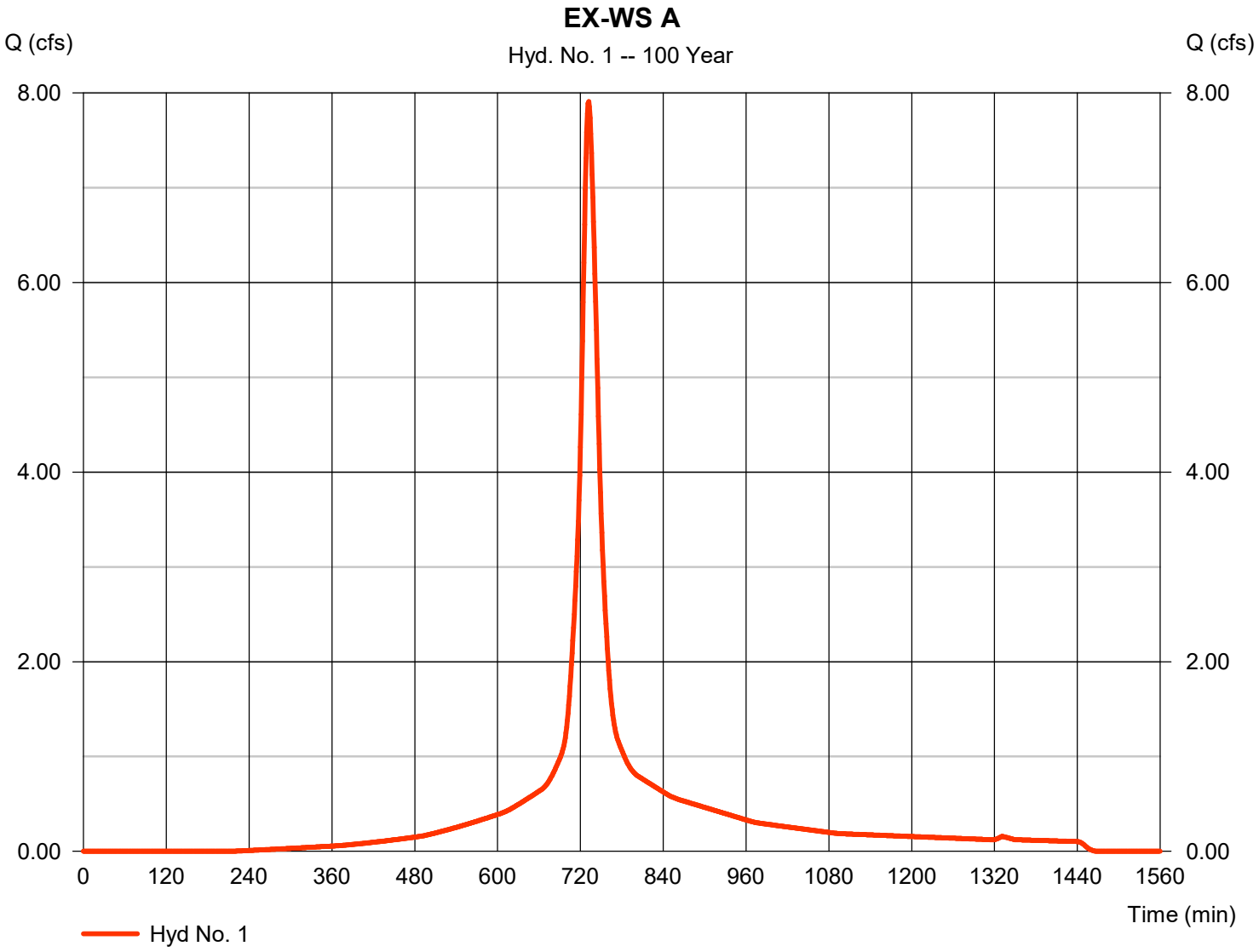
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	7.911	1	732	35,153	------	------	------	EX-WS A
2	SCS Runoff	16.24	1	738	80,964	------	------	------	EX-WS B
3	Combine	23.40	1	736	116,117	1, 2	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

EX-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.911 cfs
Storm frequency	=	100 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	35,153 cuft
Drainage area	=	1.420 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	8.46 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



APPENDIX B

Proposed Stormwater Discharge Calculations

Project **USJ O'CONNELL ATHLETIC CENTER** By **KMS** Date **8/23/2019**

Location **WEST HARTFORD, CT** Checked **KEG** Date **8/23/2019**

Circle one: Present (Developed) **PR-WS A**

1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1] Table 2-2	CN [1] Fig. 2-3	CN [1] Fig. 2-4	Area [x] acres [ ] mi^2 [ ] %	Product of CN x area
C	**Impervious**	**98**			**0.89**	**86.74**
C	**Open Space, Good Cond.**	**74**			**0.21**	**15.54**
C	**Woods, Good Condition**	**70**			**0.07**	**5.05**
B	**Open Space, Good Cond.**	**61**			**0.15**	**9.08**
1 Use only one CN source per line				Totals =	**1.32**	**116.41**

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{116.41}{1.32} =$ 88.45 Use CN = **88**

2. Runoff

		Storm 1	Storm 2	Storm 3
Frequency	yr			
Rainfall, P (24-hour)	in			
S				
Runoff, Q	in			

(Use P and CN with Table 2-1, Fig. 2-1,

Project **USJ O'CONNELL ATHLETIC CENTER** By **KMS** Date **8/23/2019**

Location **WEST HARTFORD, CT** Checked **KEG** Date **8/23/2019**

Circle one: Present (Developed) **PR-WS B1 (SC 740)**

1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1] Table 2-2	CN [1] Fig. 2-3	CN [1] Fig. 2-4	Area [x] acres [ ] mi^2 [ ] %	Product of CN x area
C	**Impervious**	**98**			**0.76**	**74.20**
C	**Open Space, Good Cond.**	**74**			**0.41**	**30.18**
C	**Woods, Good Condition**	**70**			**0.19**	**13.20**
B	**Open Space, Good Cond.**	**61**			**0.26**	**15.78**
B	**Woods, Good Condition**	**55**			**0.01**	**0.77**
1 Use only one CN source per line				Totals =	**1.63**	**134.13**

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{134.13}{1.63} =$ 82.48 Use CN = **82**

2. Runoff

		Storm 1	Storm 2	Storm 3
Frequency	yr			
Rainfall, P (24-hour)	in			
S				
Runoff, Q	in			

(Use P and CN with Table 2-1, Fig. 2-1,

Project **USJ O'CONNELL ATHLETIC CENTER** By **KMS** Date **8/23/2019**

Location **WEST HARTFORD, CT** Checked **KEG** Date **8/23/2019**

Circle one: Present (Developed) **PR-WS B2**

1. Runoff Curve Number (CN)

Soil Name and hydrologic group (Appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1] Table 2-2	CN [1] Fig. 2-3	CN [1] Fig. 2-4	Area [x] acres [ ] mi^2 [ ] %	Product of CN x area
C	**Impervious**	**98**			**0.77**	**75.50**
C	**Open Space, Good Cond.**	**74**			**0.37**	**27.68**
C	**Woods, Good Condition**	**70**			**0.03**	**2.20**
B	**Open Space, Good Cond.**	**61**			**1.28**	**77.98**
B	**Woods, Good Condition**	**55**			**0.38**	**20.68**
1 Use only one CN source per line				Totals =	**2.83**	**204.03**

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{204.03}{2.83} =$ 72.09 Use CN = **72**

2. Runoff

		Storm 1	Storm 2	Storm 3
Frequency	yr			
Rainfall, P (24-hour)	in			
S				
Runoff, Q	in			

(Use P and CN with Table 2-1, Fig. 2-1,

Project **O'Connell Athletic Center Expansion** By **KMS** Date **8/23/2019**

Location **West Hartford, CT** Checked **KEG** Date **8/23/2019**

Circle One: Present (Developed)

Circle One: (T_c) T_t through subarea **PR-WS A**

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c Only)		Segment ID	AB	BC				
1. Surface description (table 3-1)			Smooth Surface	Dense Grasses				
2. Manning's roughness coeff., n (table 3-1)			0.01	0.24				
3. Flow Length, L (total L ≤ 300 ft)		ft	40	110				
4. Two-yr 24-hr rainfall, P_2		in	3.3	3.3				
5. Land slope, s		ft/ft	0.020	0.025				
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t	hr	0.010	+ 0.231	+	=	0.241	

Shallow concentrated flow		Segment ID	CD	DE	EF			
7. Surface description (paved or unpaved)			Unpaved	Unpaved	Paved			
8. Flow length, L		ft	230	140	270			
9. Watercourse slope, s		ft/ft	0.030	0.300	0.020			
10. Average velocity, V (figure 3-1)		ft/s	2.8	8.8	2.9			
11. $T_t = \frac{L}{3600\ V}$	Compute T_t	hr	0.023	+ 0.004	+ 0.026	=	0.053	

Channel flow		Segment ID	FG			
12. Cross sectional flow area, a		ft^2				
13. Wetted perimeter, p_w		ft				
14. Hydraulic radius, r $r = \frac{a}{p_w}$	Compute r	ft				
15. Channel slope, s		ft/ft				
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Compute V	ft/s	5.00			
18. Flow length, L		ft	60			
19. $T_t = \frac{L}{3600\ V}$	Compute T_t	hr	0.003	+	=	0.003
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19)						0.297 hr

Use Tc= 18 min

Project **O'Connell Athletic Center Expansion** By **KMS** Date **8/23/2019**

Location **West Hartford, CT** Checked **KEG** Date **8/23/2019**

Circle One: Present (Developed)

Circle One: (T_c) T_t through subarea **PR-WS B1 (SC-740)**

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c Only)		Segment ID	AB					
1. Surface description (table 3-1)			Dense Grasses					
2. Manning's roughness coeff., n (table 3-1)			0.24					
3. Flow Length, L (total L ≤ 300 ft)		ft	150					
4. Two-yr 24-hr rainfall, P_2		in	3.3					
5. Land slope, s		ft/ft	0.030					
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t	hr	0.275	+		+	=	0.275

Shallow concentrated flow		Segment ID	BC/DE	CD		
7. Surface description (paved or unpaved)			Unpaved	Unpaved		
8. Flow length, L		ft	290	25		
9. Watercourse slope, s		ft/ft	0.030	0.300		
10. Average velocity, V (figure 3-1)		ft/s	2.8	8.8		
11. $T_t = \frac{L}{3600\ V}$	Compute T_t	hr	0.029	+ 0.001	=	0.030

Channel flow		Segment ID	EF			
12. Cross sectional flow area, a		ft^2				
13. Wetted perimeter, p_w		ft				
14. Hydraulic radius, r $r = \frac{a}{p_w}$	Compute r	ft				
15. Channel slope, s		ft/ft				
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Compute V	ft/s	5.00			
18. Flow length, L		ft	65			
19. $T_t = \frac{L}{3600\ V}$	Compute T_t	hr	0.004	+	=	0.004

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) **0.309** hr

Use Tc= 19 min

Project **O'Connell Athletic Center Expansion** By **KMS** Date **8/23/2019**

Location **West Hartford, CT** Checked **KEG** Date **8/23/2019**

Circle One: Present (Developed)

Circle One: (T_c) T_t through subarea **PR-WS B2**

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c Only)		Segment ID	AB	BC			
1. Surface description (table 3-1)			Smooth Surface	Light Underbrush			
2. Manning's roughness coeff., n (table 3-1)			0.01	0.40			
3. Flow Length, L (total L ≤ 300 ft)		ft	30	120			
4. Two-yr 24-hr rainfall, P_2		in	3.3	3.3			
5. Land slope, s		ft/ft	0.020	0.025			
6. $T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t	hr	0.008	+ 0.373	+	=	0.381

Shallow concentrated flow		Segment ID	CD	DE			
7. Surface description (paved or unpaved)			Unpaved	Unpaved			
8. Flow length, L		ft	270	10			
9. Watercourse slope, s		ft/ft	0.030	0.300			
10. Average velocity, V (figure 3-1)		ft/s	2.8	8.8			
11. $T_t = \frac{L}{3600\ V}$	Compute T_t	hr	0.027	+ 0.000		=	0.027

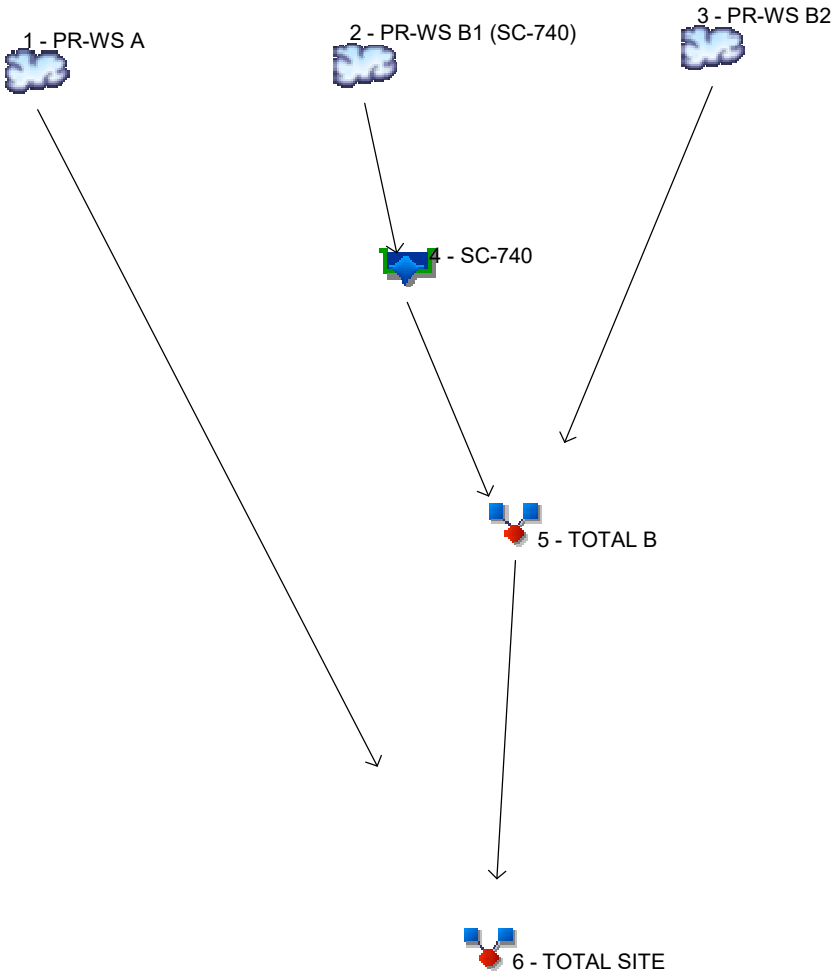
Channel flow		Segment ID	EF				
12. Cross sectional flow area, a		ft^2					
13. Wetted perimeter, p_w		ft					
14. Hydraulic radius, r $r = \frac{a}{p_w}$	Compute r	ft					
15. Channel slope, s		ft/ft					
16. Manning's roughness coeff., n							
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Compute V	ft/s	5.00				
18. Flow length, L		ft	490				
19. $T_t = \frac{L}{3600\ V}$	Compute T_t	hr	0.027	+		=	0.027

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) **0.435** hr

Use Tc= 26 min

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

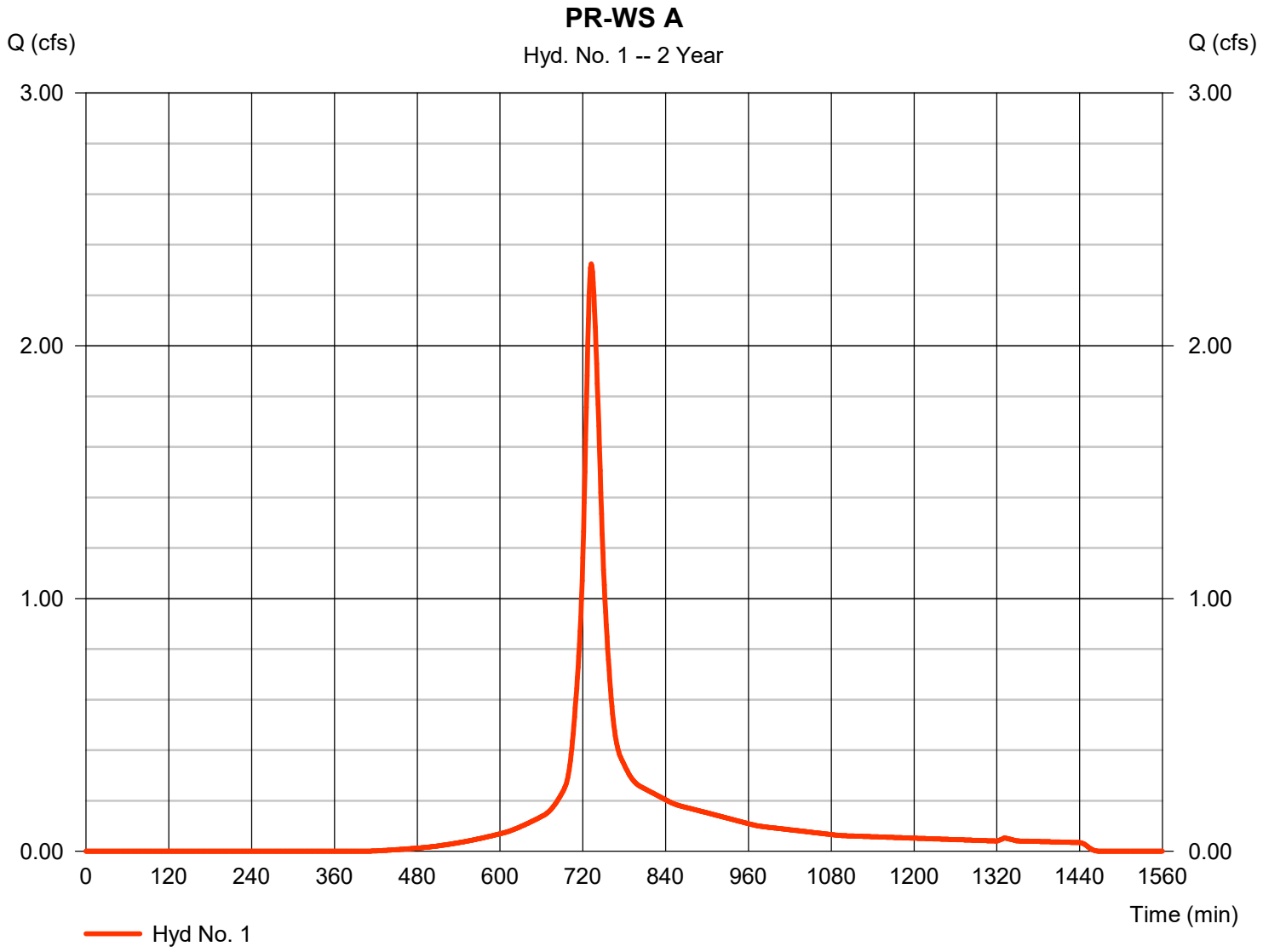
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.323	1	732	9,887	------	------	------	PR-WS A
2	SCS Runoff	2.163	1	734	9,579	------	------	------	PR-WS B1 (SC-740)
3	SCS Runoff	1.917	1	741	10,273	------	------	------	PR-WS B2
4	Reservoir	1.229	1	751	7,961	2	102.19	3,309	SC-740
5	Combine	3.035	1	746	18,235	3, 4	------	------	TOTAL B
6	Combine	4.772	1	740	28,122	1, 5	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

PR-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.323 cfs
Storm frequency	=	2 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	9,887 cuft
Drainage area	=	1.320 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	3.30 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

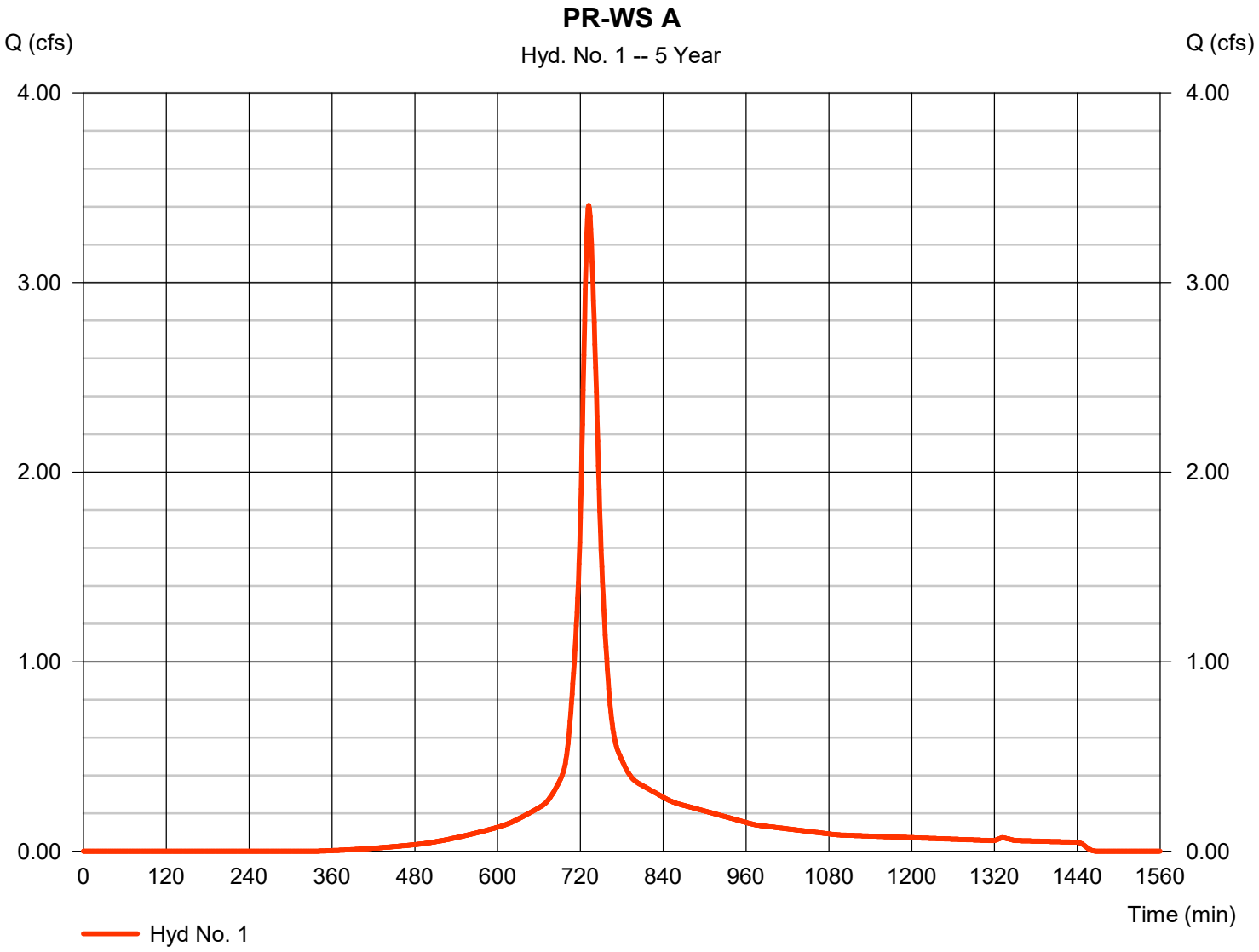
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	3.407	1	732	14,652	------	------	------	PR-WS A
2	SCS Runoff	3.406	1	734	15,028	------	------	------	PR-WS B1 (SC-740)
3	SCS Runoff	3.525	1	740	18,009	------	------	------	PR-WS B2
4	Reservoir	2.149	1	748	13,411	2	102.64	4,554	SC-740
5	Combine	5.553	1	742	31,420	3, 4	------	------	TOTAL B
6	Combine	8.433	1	737	46,072	1, 5	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

PR-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.407 cfs
Storm frequency	=	5 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	14,652 cuft
Drainage area	=	1.320 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	4.39 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

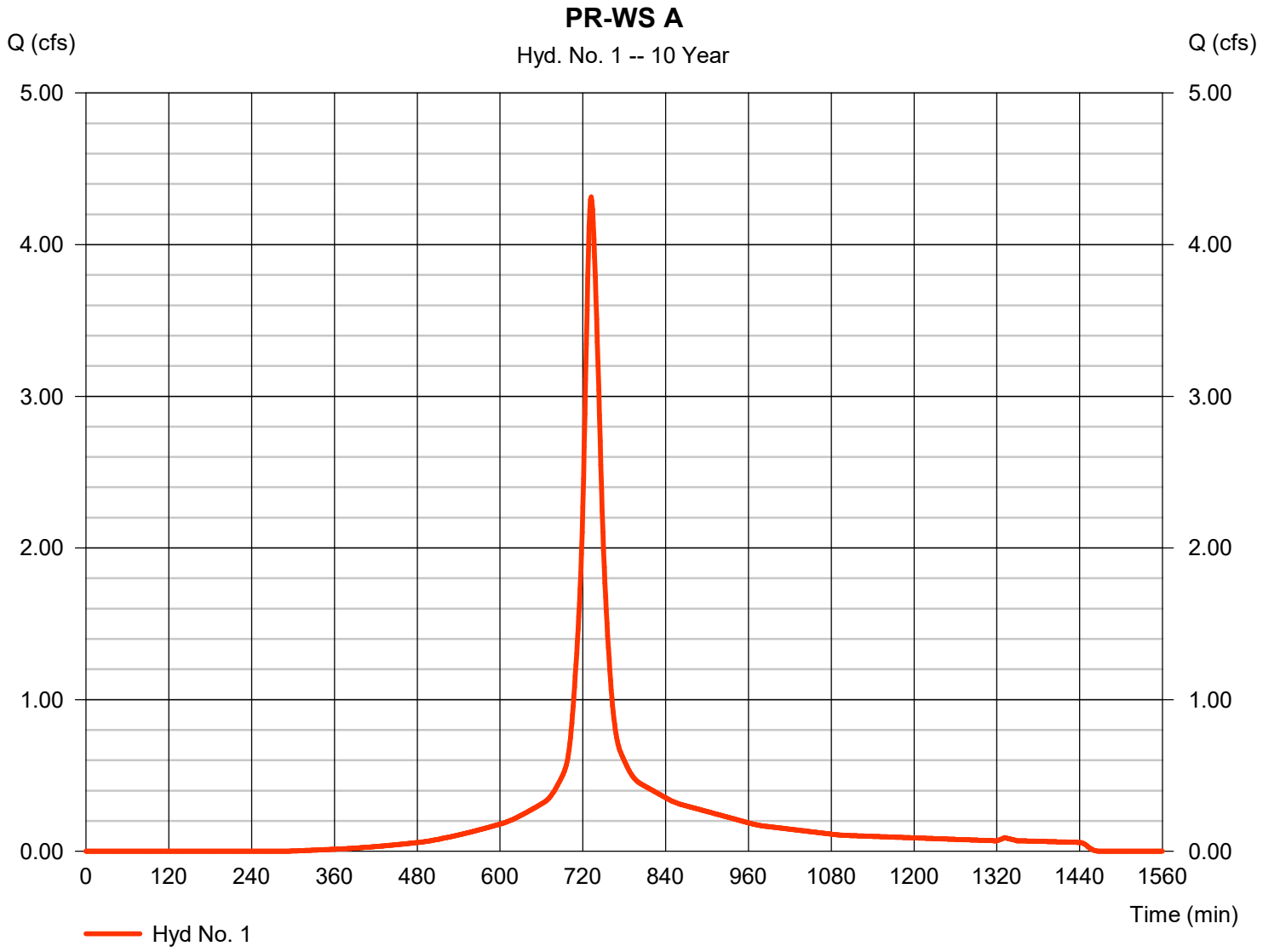
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.314	1	732	18,734	------	------	------	PR-WS A
2	SCS Runoff	4.478	1	733	19,814	------	------	------	PR-WS B1 (SC-740)
3	SCS Runoff	5.007	1	739	25,172	------	------	------	PR-WS B2
4	Reservoir	2.992	1	747	18,197	2	103.01	5,546	SC-740
5	Combine	7.798	1	742	43,369	3, 4	------	------	TOTAL B
6	Combine	11.38	1	738	62,103	1, 5	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

PR-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.314 cfs
Storm frequency	=	10 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	18,734 cuft
Drainage area	=	1.320 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	5.30 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

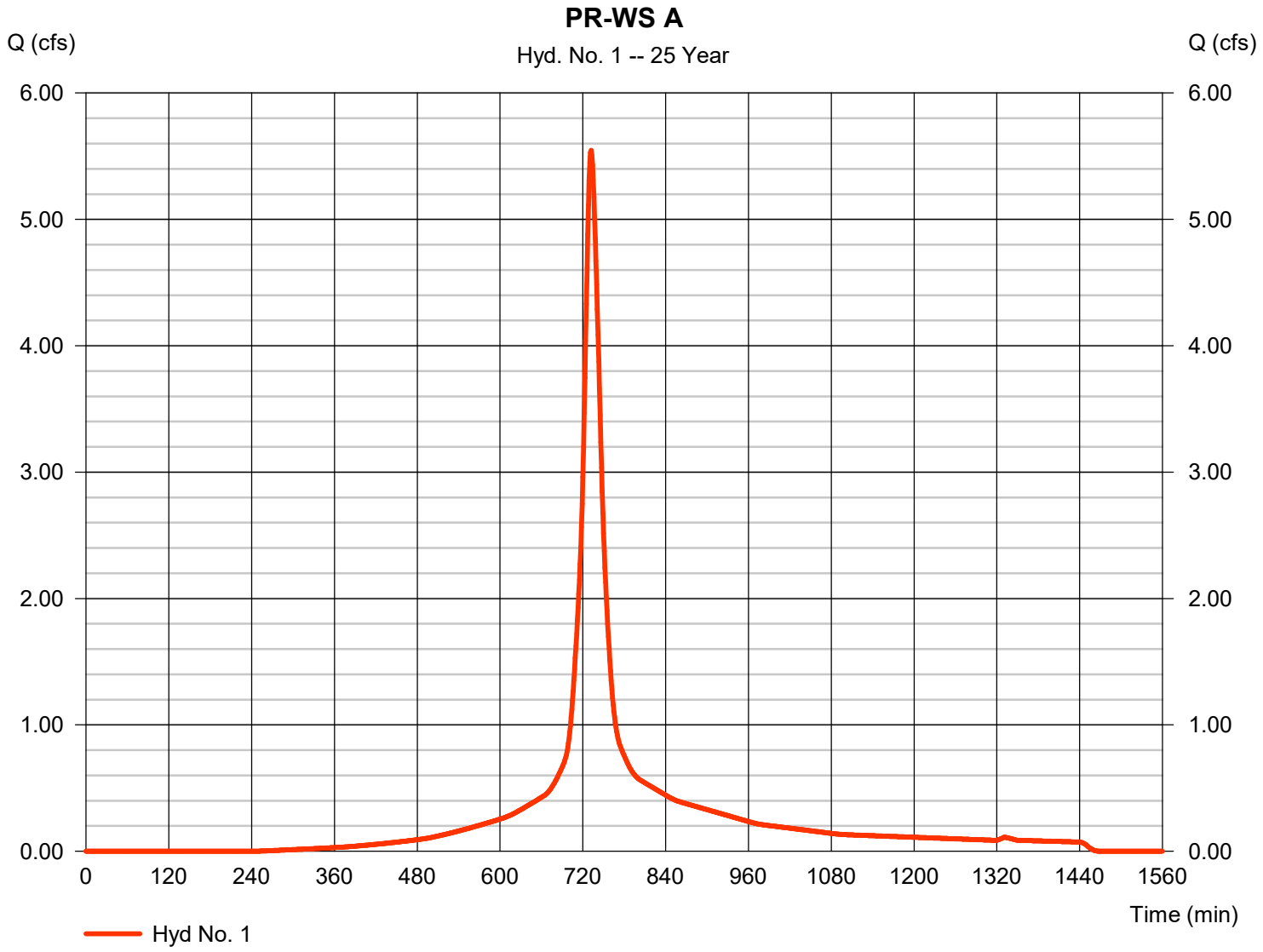
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	5.546	1	732	24,384	------	------	------	PR-WS A
2	SCS Runoff	5.960	1	733	26,547	------	------	------	PR-WS B1 (SC-740)
3	SCS Runoff	7.138	1	739	35,619	------	------	------	PR-WS B2
4	Reservoir	4.005	1	746	24,930	2	103.51	6,768	SC-740
5	Combine	10.91	1	741	60,548	3, 4	------	------	TOTAL B
6	Combine	15.67	1	737	84,932	1, 5	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

PR-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.546 cfs
Storm frequency	=	25 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	24,384 cuft
Drainage area	=	1.320 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	6.54 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

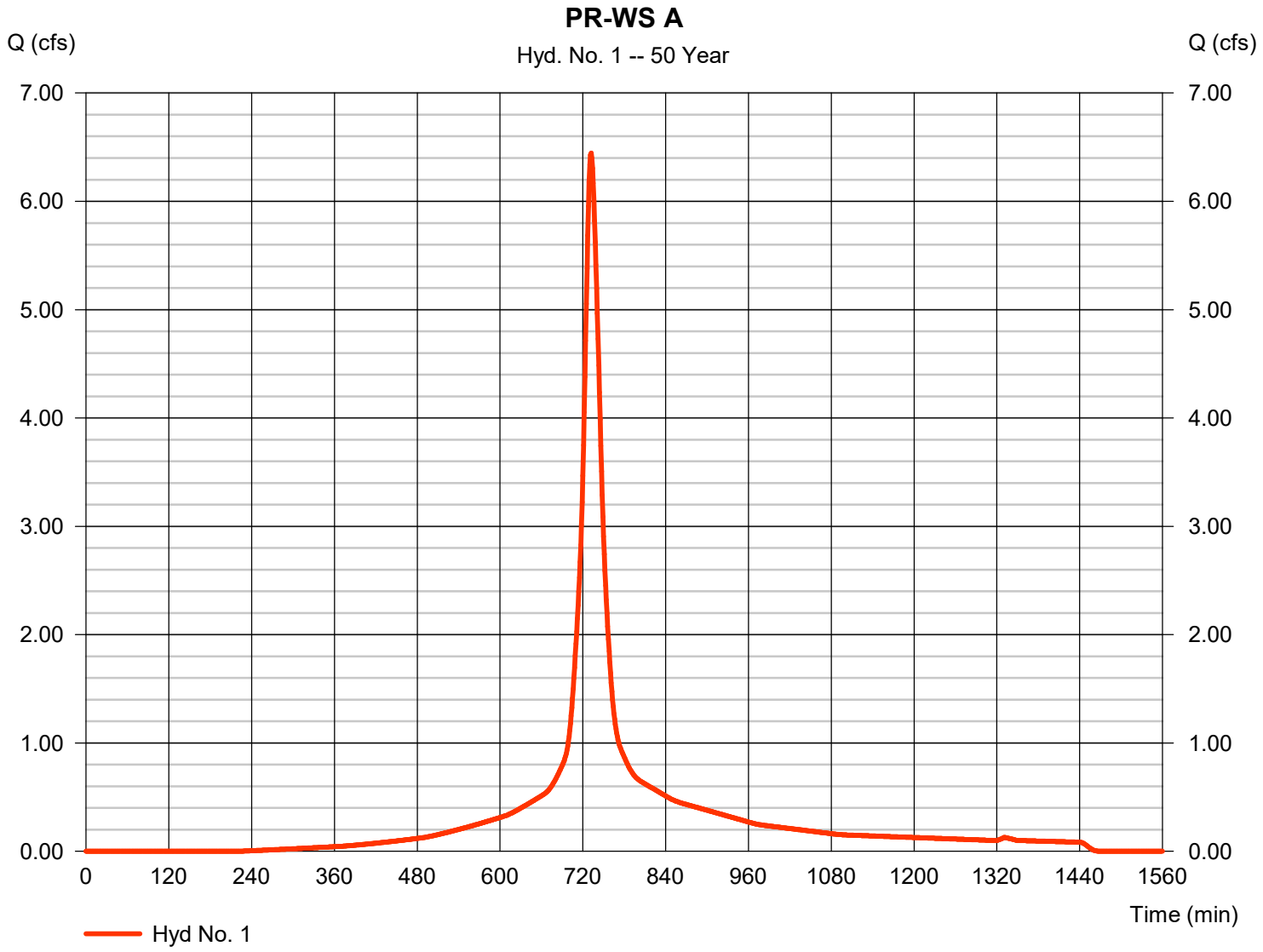
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	6.444	1	732	28,571	------	------	------	PR-WS A
2	SCS Runoff	7.052	1	733	31,592	------	------	------	PR-WS B1 (SC-740)
3	SCS Runoff	8.761	1	738	43,642	------	------	------	PR-WS B2
4	Reservoir	4.693	1	746	29,975	2	104.01	7,719	SC-740
5	Combine	13.12	1	740	73,617	3, 4	------	------	TOTAL B
6	Combine	18.71	1	737	102,188	1, 5	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

PR-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.444 cfs
Storm frequency	=	50 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	28,571 cuft
Drainage area	=	1.320 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	7.45 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

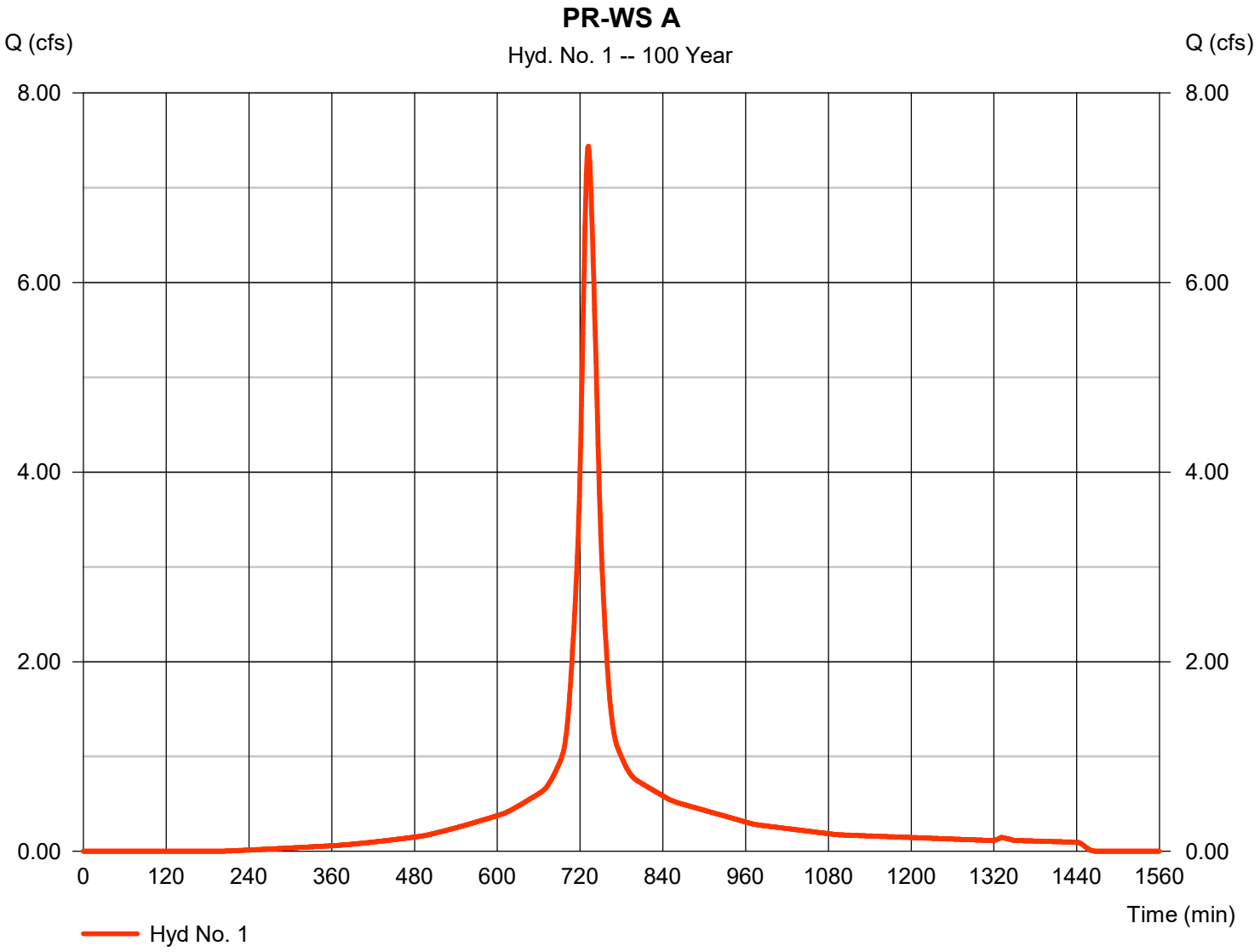
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	7.438	1	732	33,247	------	------	------	PR-WS A
2	SCS Runoff	8.264	1	733	37,262	------	------	------	PR-WS B1 (SC-740)
3	SCS Runoff	10.60	1	738	52,805	------	------	------	PR-WS B2
4	Reservoir	6.136	1	744	35,645	2	104.62	8,540	SC-740
5	Combine	16.22	1	743	88,449	3, 4	------	------	TOTAL B
6	Combine	22.20	1	738	121,696	1, 5	------	------	TOTAL SITE

Hydrograph Report

Hyd. No. 1

PR-WS A

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.438 cfs
Storm frequency	=	100 yrs	Time to peak	=	732 min
Time interval	=	1 min	Hyd. volume	=	33,247 cuft
Drainage area	=	1.320 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.00 min
Total precip.	=	8.46 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 08 / 19 / 2019

Pond No. 1 - SC-740

Pond Data

UG Chambers -Invert elev. = 101.50 ft, Rise x Span = 2.50 x 4.25 ft, Barrel Len = 59.00 ft, No. Barrels = 9, Slope = 0.00%, Headers = Yes
Encasement -Invert elev. = 100.50 ft, Width = 5.25 ft, Height = 4.25 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.50	n/a	0	0
0.43	100.93	n/a	558	558
0.85	101.35	n/a	558	1,117
1.27	101.78	n/a	996	2,113
1.70	102.20	n/a	1,222	3,335
2.13	102.63	n/a	1,189	4,524
2.55	103.05	n/a	1,130	5,654
2.97	103.47	n/a	1,037	6,691
3.40	103.90	n/a	879	7,569
3.83	104.32	n/a	588	8,158
4.25	104.75	n/a	558	8,716

Culvert / Orifice Structures

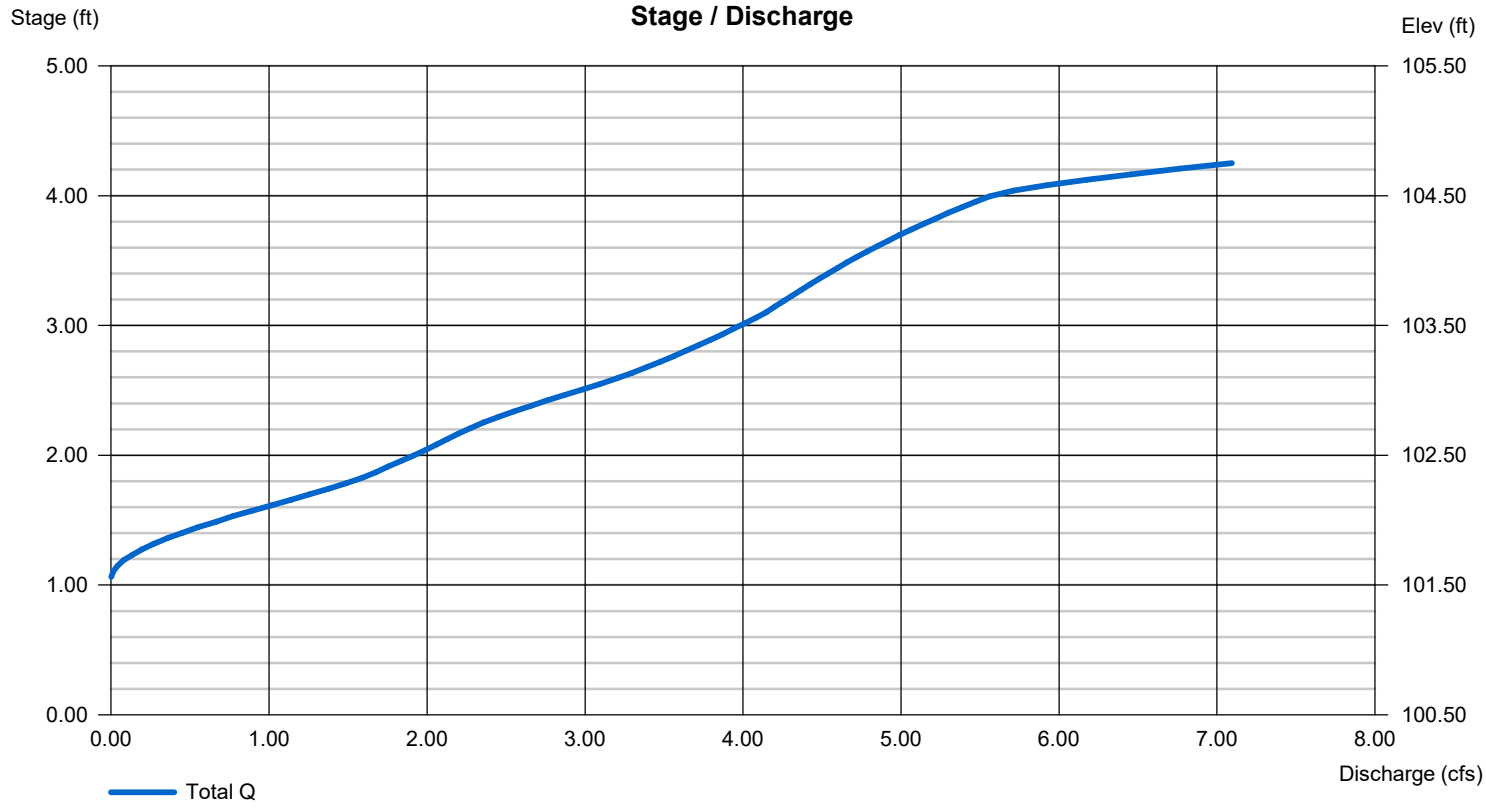
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	10.00	6.00	0.00
Span (in)	= 15.00	10.00	6.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 100.50	101.55	102.65	0.00
Length (ft)	= 50.00	0.50	0.50	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 3.00	0.00	0.00	0.00
Crest El. (ft)	= 104.50	103.60	0.00	0.00
Weir Coeff.	= 3.33	0.68	3.33	3.33
Weir Type	= Rect	30 degV	---	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

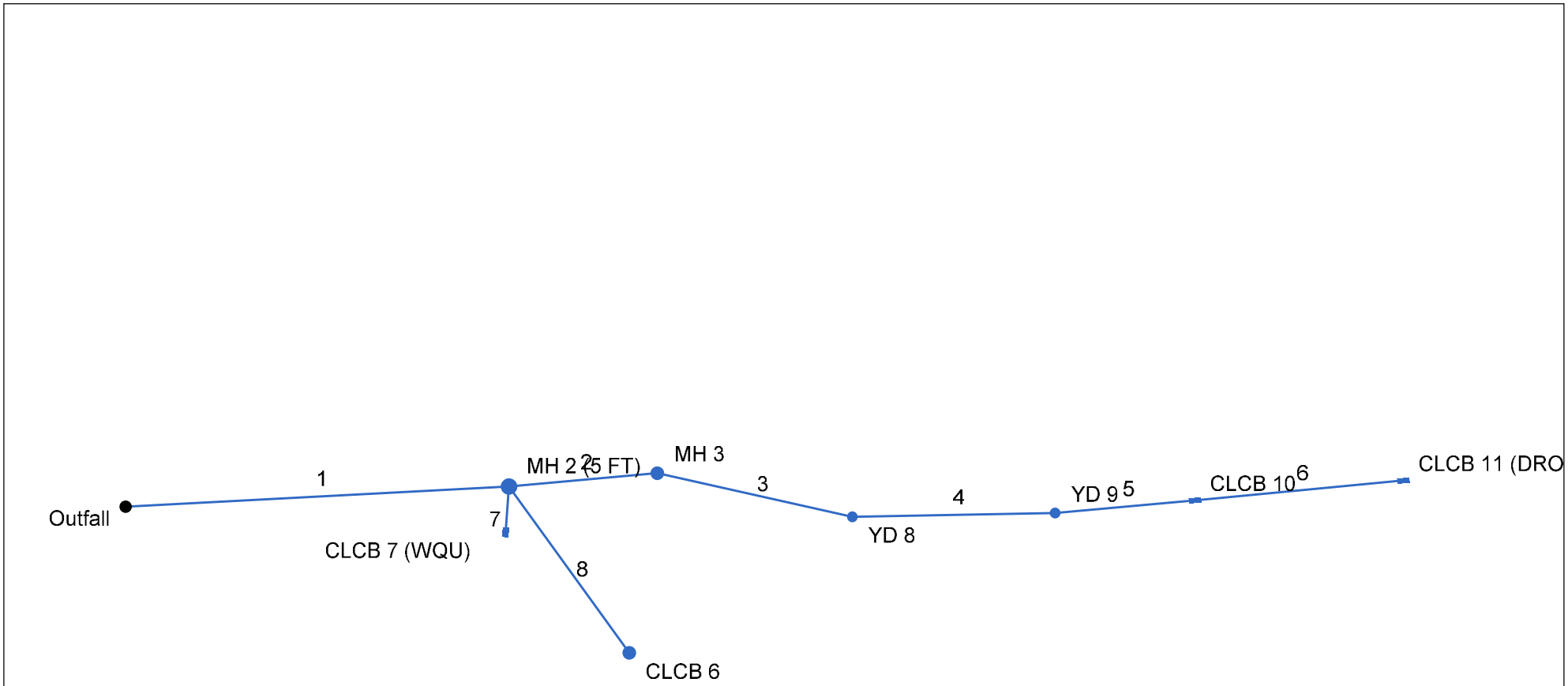
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



APPENDIX C

Stormwater Collection System Calculations

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 08-16-2019 Storm East.stm	Number of lines: 8	Date: 8/23/2019

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	134.740	0.00	2.83	0.00	0.00	1.21	0.0	22.4	3.4	7.12	8.15	6.09	15	2.12	97.05	99.91	98.30	100.98	100.27	103.31	EX FES-MH2
2	1	52.325	0.00	1.54	0.00	0.00	0.55	0.0	22.1	3.4	4.86	4.58	4.20	15	0.67	99.91	100.26	101.03	101.38	103.31	105.00	MH2-MH3
3	2	71.027	0.07	1.54	0.62	0.04	0.55	6.0	21.9	3.4	1.88	4.71	4.81	12	1.49	101.13	102.19	101.57	102.77	105.00	106.80	MH3-YD8
4	3	71.142	0.12	1.47	0.43	0.05	0.50	5.0	21.6	3.5	1.75	4.73	3.76	12	1.50	102.19	103.26	102.77	103.82	106.80	106.50	YD8-YD9
5	4	49.293	0.13	1.35	0.37	0.05	0.45	12.0	21.4	3.5	1.58	4.73	3.59	12	1.50	103.26	104.00	103.82	104.53	106.50	107.00	YD9-CLCB10
6	5	73.641	1.22	1.22	0.33	0.40	0.40	21.0	21.0	3.5	1.42	10.91	3.47	12	8.00	104.00	109.89	104.53	110.39	107.00	120.50	CLCB10-CLCB11
7	1	20.009	0.37	0.37	0.73	0.27	0.27	5.0	5.0	7.5	2.02	2.18	3.15	12	0.50	100.80	100.90	101.56	101.66	103.31	102.90	MH2-CLCB7
8	1	83.712	0.92	0.92	0.43	0.40	0.40	15.0	15.0	4.3	1.71	2.21	2.65	12	0.51	100.11	100.54	100.98	101.24	103.31	102.40	MH2-CLCB6

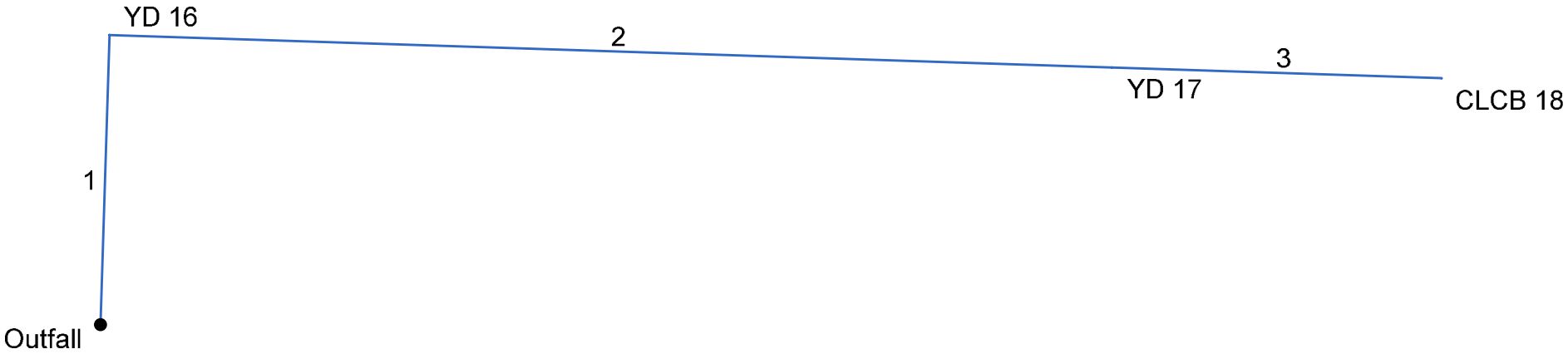
Project File: 08-16-2019 Storm East.stm

Number of lines: 8

Run Date: 8/23/2019

NOTES:Intensity = 35.55 / (Inlet time + 3.70) ^ 0.72; Return period =Yrs. 10 ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Storm-North.stm	Number of lines: 3	Date: 8/21/2019

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	10.116	0.07	0.81	0.42	0.03	0.26	9.0	18.2	3.9	1.01	0.92	3.52	8	0.49	103.58	103.63	104.06	104.19	107.60	106.30	PR BLDG-YD 16
2	1	34.610	0.04	0.74	0.58	0.02	0.23	11.0	18.1	3.9	0.90	2.22	3.10	8	2.89	103.63	104.63	104.43	105.08	106.30	107.30	YD16-YD17
3	2	11.349	0.70	0.70	0.30	0.21	0.21	18.0	18.0	3.9	0.82	1.86	3.35	8	2.03	104.63	104.86	105.08	105.29	107.30	111.70	YD17-CLCB18

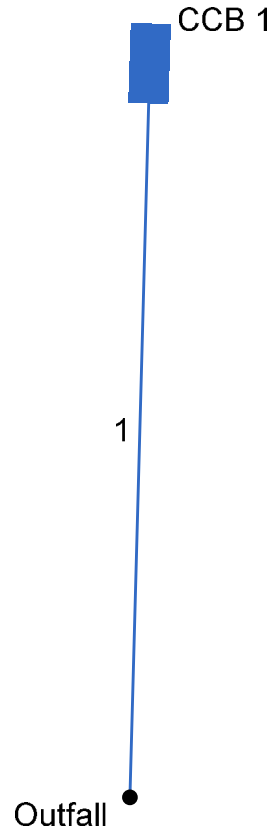
Project File: Storm-North.stm

Number of lines: 3

Run Date: 8/21/2019

NOTES:Intensity = 35.55 / (Inlet time + 3.70) ^ 0.72; Return period =Yrs. 10 ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Storm-Northwest.stm	Number of lines: 1	Date: 8/21/2019

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	37.130	0.60	0.60	0.46	0.28	0.28	18.0	18.0	3.9	1.07	5.45	3.27	12	1.99	100.76	101.50	101.20	101.94	104.40	104.50	EX-CCB1

Project File: Storm-Northwest.stm

Number of lines: 1

Run Date: 8/21/2019

NOTES:Intensity = 35.55 / (Inlet time + 3.70) ^ 0.72; Return period =Yrs. 10 ; c = cir e = ellip b = box

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan

Project File: 08-16-2019 Storm East CLCB 5.stm	Number of lines: 1	Date: 8/21/2019

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	54.182	0.25	0.25	0.69	0.17	0.17	5.0	5.0	7.5	1.29	3.85	3.47	12	1.00	101.06	101.60	101.54	102.08	106.00	104.60	SC740-CLCB5

Project File: 08-16-2019 Storm East CLCB 5.stm

Number of lines: 1

Run Date: 8/21/2019

NOTES:Intensity = 35.55 / (Inlet time + 3.70) ^ 0.72; Return period =Yrs. 10 ; c = cir e = ellip b = box

Project **USJ O'Connell Center** By **KMS** Date **8/21/2019**

Location **West Hartford, CT** Checked **KEG** Date **8/21/2019**

Circle one: Present (Developed) Job No. **140202901**

Catchment Area	Area		Impervious (C=0.9)		Gravel (C=0.6)		Pervious (C=0.3)		C
	[SF]	[AC]	[SF]	[AC]	[SF]	[AC]	[SF]	[AC]	
CCB 1	26292	0.60	6801	0.16	0	0.00	19491	0.45	0.46
CLCB 5	10887	0.25	6461	0.15	1384	0.03	3042	0.07	0.69
CLCB 6	40117	0.92	8649	0.20	219	0.01	31249	0.72	0.43
CLCB 7	16272	0.37	11226	0.26	910	0.02	4136	0.09	0.73
YD 8	3197	0.07	1614	0.04	205	0.00	1378	0.03	0.62
YD 9	5070	0.12	862	0.02	478	0.01	3730	0.09	0.43
CLCB 10	5707	0.13	665	0.02	21	0.00	5021	0.12	0.37
CLCB 11	52994	1.22	2215	0.05	0	0.00	50779	1.17	0.33
YD 16	3119	0.07	616	0.01	0	0.00	2503	0.06	0.42
YD 17	1777	0.04	834	0.02	0	0.00	943	0.02	0.58
CLCB 18	30393	0.70	0	0.00	0	0.00	30393	0.70	0.30

STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

WQV = (1")(R)(A) / 12

WQV= water quality volume *(acre-feet)*
R= volumetric runoff coefficient
I = percent impervious cover
A= site area *(acres)*

WQF = (q_u)(A)(Q)

WQF = water quality flow *(cfs)*
q_u= unit peak discharge *(cfs/mi^2/inch)*
A= drainage area *(mi^2)*
Q= runoff depth *(watershed inches)*
= [WQV *(acre-feet)*]x[12 *(inches/foot)*] / Drainage area *(acres)*

Site Characteristics (Water Quality Unit - CLCB 5)

Description (Water Quality Unit - CLCB 5)

Area	0.25	acres	0.000391	mi^2
Impervious Area	0.15	acres		
I	60.0	%		
R = 0.05+ 0.009(I) =	0.590			
WQV=	**0.01**	**acre-ft**	535	cf
P=Precipitation	1	inch		
Ia=Initial Abstraction (Exhibit 4-1)	0.273			
Tc=Time of Concentration	5	minutes	0.083333	hours
Qu=unit peak discharge (Exhibit 4-III)	610	cfs/mi^2/inch		
A=Drainage Area	0.25	acres	0.000391	mi^2
Q=Runoff Depth	0.6	watershed inches		
WQF=	**0.14**	**cfs**		

O'Connell Athletic Center West Hartford, CT	BY	AG	DATE	8/21/2019	PROJ NO.	140202901
	CKD	CPC	DATE	8/21/2019	SHEET	1 of 1

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ENGINEERING & ENVIRONMENTAL SERVICES

STORMWATER QUALITY CALCULATIONS

Methodology: Water Quality Volume and Flow

Reference: 2004 Stormwater Quality Manual

WQV = (1")(R)(A) / 12

WQV= water quality volume *(acre-feet)*
R= volumetric runoff coefficient
I = percent impervious cover
A= site area *(acres)*

WQF = (q_u)(A)(Q)

WQF = water quality flow *(cfs)*
q_u= unit peak discharge *(cfs/mi^2/inch)*
A= drainage area *(mi^2)*
Q= runoff depth *(watershed inches)*
= [WQV *(acre-feet)*]x[12 *(inches/foot)*] / Drainage area *(acres)*

Site Characteristics (Water Quality Unit - CLCB 7)

Description (Water Quality Unit - CLCB 7)

Area	0.37	acres	0.000578	mi^2
Impervious Area	0.26	acres		
I	70.3	%		
R = 0.05+ 0.009(I) =	0.682			
WQV=	**0.02**	**acre-ft**	917	cf

P=Precipitation	1	inch		
Ia=Initial Abstraction (Exhibit 4-1)	0.273			
Tc=Time of Concentration	5	minutes	0.083333	hours

Qu=unit peak discharge (Exhibit 4-III)	610	cfs/mi^2/inch		
A=Drainage Area	0.37	acres	0.000578	mi^2
Q=Runoff Depth	0.7	watershed inches		
WQF=	**0.24**	**cfs**		

O'Connell Athletic Center West Hartford, CT	BY	AG	DATE	8/21/2019	PROJ NO.	140202901
	CKD	CPC	DATE	8/21/2019	SHEET	1 of 1

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APPENDIX D

NOAA Rainfall Data

NOAA Atlas 14, Volume 10, Version 3 WEST HARTFORD
Station ID: 06-9162
Location name: Town of West Hartford, Connecticut, USA*
Latitude: 41.75°, Longitude: -72.7833°
Elevation:
Elevation (station metadata): 275 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.343 (0.265-0.443)	0.414 (0.319-0.535)	0.530 (0.407-0.688)	0.625 (0.478-0.817)	0.757 (0.562-1.04)	0.857 (0.623-1.20)	0.961 (0.680-1.40)	1.08 (0.724-1.61)	1.25 (0.806-1.93)	1.38 (0.874-2.18)
10-min	0.486 (0.375-0.628)	0.586 (0.452-0.758)	0.750 (0.576-0.974)	0.886 (0.677-1.16)	1.07 (0.796-1.47)	1.21 (0.883-1.70)	1.36 (0.963-1.98)	1.53 (1.03-2.28)	1.76 (1.14-2.73)	1.96 (1.24-3.09)
15-min	0.571 (0.441-0.738)	0.689 (0.532-0.892)	0.882 (0.678-1.15)	1.04 (0.797-1.36)	1.26 (0.936-1.73)	1.43 (1.04-2.00)	1.60 (1.13-2.33)	1.80 (1.21-2.68)	2.07 (1.34-3.21)	2.30 (1.46-3.64)
30-min	0.773 (0.597-0.999)	0.933 (0.720-1.21)	1.20 (0.918-1.55)	1.41 (1.08-1.85)	1.71 (1.27-2.34)	1.94 (1.41-2.71)	2.17 (1.54-3.16)	2.44 (1.64-3.64)	2.82 (1.82-4.36)	3.13 (1.98-4.94)
60-min	0.975 (0.753-1.26)	1.18 (0.908-1.52)	1.51 (1.16-1.96)	1.79 (1.36-2.33)	2.16 (1.60-2.96)	2.45 (1.78-3.43)	2.75 (1.94-3.99)	3.08 (2.07-4.59)	3.56 (2.30-5.50)	3.95 (2.50-6.24)
2-hr	1.26 (0.979-1.62)	1.52 (1.18-1.95)	1.94 (1.50-2.50)	2.29 (1.76-2.97)	2.77 (2.07-3.78)	3.13 (2.30-4.38)	3.51 (2.51-5.13)	3.97 (2.67-5.89)	4.64 (3.02-7.16)	5.22 (3.31-8.21)
3-hr	1.45 (1.13-1.86)	1.75 (1.37-2.24)	2.24 (1.74-2.88)	2.65 (2.04-3.43)	3.21 (2.41-4.37)	3.62 (2.67-5.06)	4.07 (2.93-5.94)	4.61 (3.11-6.83)	5.43 (3.53-8.36)	6.14 (3.91-9.65)
6-hr	1.83 (1.44-2.33)	2.23 (1.75-2.83)	2.87 (2.24-3.66)	3.40 (2.64-4.36)	4.13 (3.12-5.60)	4.67 (3.46-6.50)	5.25 (3.81-7.67)	5.98 (4.05-8.83)	7.11 (4.64-10.9)	8.08 (5.16-12.7)
12-hr	2.26 (1.79-2.85)	2.77 (2.19-3.51)	3.62 (2.85-4.59)	4.32 (3.38-5.51)	5.28 (4.02-7.14)	5.99 (4.47-8.31)	6.77 (4.94-9.86)	7.74 (5.26-11.4)	9.25 (6.05-14.1)	10.6 (6.76-16.5)
24-hr	2.64 (2.10-3.31)	3.30 (2.63-4.15)	4.39 (3.48-5.54)	5.30 (4.17-6.72)	6.54 (5.01-8.82)	7.45 (5.61-10.3)	8.46 (6.24-12.4)	9.76 (6.66-14.3)	11.9 (7.78-18.1)	13.7 (8.80-21.3)
2-day	2.94 (2.36-3.66)	3.77 (3.02-4.70)	5.12 (4.08-6.41)	6.24 (4.95-7.87)	7.79 (6.02-10.5)	8.90 (6.78-12.4)	10.2 (7.61-15.0)	11.9 (8.13-17.4)	14.8 (9.71-22.4)	17.3 (11.2-26.9)
3-day	3.20 (2.57-3.96)	4.11 (3.30-5.10)	5.60 (4.48-6.98)	6.84 (5.44-8.58)	8.54 (6.63-11.5)	9.77 (7.47-13.6)	11.2 (8.40-16.4)	13.1 (8.98-19.1)	16.3 (10.8-24.8)	19.3 (12.4-29.8)
4-day	3.43 (2.77-4.24)	4.40 (3.55-5.45)	5.99 (4.81-7.45)	7.31 (5.83-9.15)	9.12 (7.10-12.2)	10.4 (7.99-14.4)	11.9 (8.98-17.5)	14.0 (9.59-20.3)	17.4 (11.5-26.4)	20.6 (13.3-31.8)
7-day	4.09 (3.32-5.03)	5.18 (4.19-6.38)	6.95 (5.61-8.60)	8.42 (6.75-10.5)	10.4 (8.16-13.9)	11.9 (9.15-16.4)	13.6 (10.2-19.8)	15.8 (10.9-22.9)	19.5 (12.9-29.5)	22.9 (14.8-35.3)
10-day	4.76 (3.88-5.84)	5.91 (4.80-7.25)	7.77 (6.29-9.58)	9.32 (7.50-11.6)	11.5 (8.96-15.2)	13.0 (10.00-17.8)	14.7 (11.1-21.3)	17.0 (11.8-24.7)	20.8 (13.8-31.4)	24.2 (15.7-37.2)
20-day	6.88 (5.64-8.38)	8.08 (6.61-9.85)	10.0 (8.18-12.3)	11.7 (9.45-14.4)	13.9 (10.9-18.2)	15.5 (12.0-20.9)	17.4 (13.0-24.5)	19.6 (13.6-28.2)	23.1 (15.4-34.7)	26.2 (17.0-40.2)
30-day	8.67 (7.13-10.5)	9.89 (8.12-12.0)	11.9 (9.73-14.5)	13.5 (11.0-16.6)	15.8 (12.4-20.5)	17.5 (13.5-23.3)	19.3 (14.4-27.0)	21.5 (15.0-30.8)	24.7 (16.5-36.9)	27.4 (17.8-41.9)
45-day	10.9 (8.98-13.1)	12.1 (10.0-14.7)	14.2 (11.7-17.2)	15.9 (13.0-19.5)	18.3 (14.4-23.4)	20.1 (15.4-26.4)	21.9 (16.2-30.1)	23.9 (16.8-34.1)	26.7 (17.9-39.7)	28.9 (18.8-44.1)
60-day	12.7 (10.5-15.3)	14.0 (11.6-16.9)	16.2 (13.3-19.6)	18.0 (14.7-21.9)	20.4 (16.1-26.0)	22.3 (17.1-29.1)	24.2 (17.8-32.8)	26.1 (18.3-37.0)	28.5 (19.2-42.2)	30.2 (19.8-46.1)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

NOAA Atlas 14, Volume 10, Version 3
Location name: Town of West Hartford, Connecticut, USA*
Latitude: 41.75°, Longitude: -72.7833°
Elevation: 286.75 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**4.12** (3.18-5.32)	**4.97** (3.83-6.42)	**6.36** (4.88-8.26)	**7.50** (5.74-9.80)	**9.08** (6.74-12.4)	**10.3** (7.48-14.4)	**11.5** (8.16-16.8)	**12.9** (8.69-19.3)	**14.9** (9.67-23.1)	**16.6** (10.5-26.2)
10-min	**2.92** (2.25-3.77)	**3.52** (2.71-4.55)	**4.50** (3.46-5.84)	**5.32** (4.06-6.94)	**6.44** (4.78-8.81)	**7.28** (5.30-10.2)	**8.17** (5.78-11.9)	**9.16** (6.16-13.7)	**10.6** (6.85-16.4)	**11.7** (7.43-18.5)
15-min	**2.28** (1.76-2.95)	**2.76** (2.13-3.57)	**3.53** (2.71-4.58)	**4.17** (3.19-5.45)	**5.05** (3.74-6.91)	**5.71** (4.15-8.00)	**6.41** (4.53-9.32)	**7.18** (4.83-10.7)	**8.30** (5.37-12.8)	**9.20** (5.82-14.5)
30-min	**1.55** (1.19-2.00)	**1.87** (1.44-2.42)	**2.39** (1.84-3.10)	**2.83** (2.16-3.69)	**3.43** (2.54-4.69)	**3.88** (2.82-5.42)	**4.35** (3.08-6.32)	**4.88** (3.28-7.27)	**5.63** (3.65-8.71)	**6.25** (3.96-9.87)
60-min	**0.975** (0.753-1.26)	**1.18** (0.908-1.52)	**1.51** (1.16-1.96)	**1.79** (1.36-2.33)	**2.16** (1.60-2.96)	**2.45** (1.78-3.43)	**2.75** (1.94-3.99)	**3.08** (2.07-4.59)	**3.56** (2.30-5.50)	**3.95** (2.50-6.24)
2-hr	**0.630** (0.490-0.808)	**0.759** (0.589-0.976)	**0.970** (0.750-1.25)	**1.14** (0.880-1.49)	**1.39** (1.04-1.89)	**1.56** (1.15-2.19)	**1.76** (1.26-2.56)	**1.98** (1.34-2.95)	**2.32** (1.51-3.58)	**2.61** (1.66-4.11)
3-hr	**0.484** (0.378-0.619)	**0.584** (0.455-0.747)	**0.747** (0.580-0.959)	**0.882** (0.681-1.14)	**1.07** (0.802-1.45)	**1.21** (0.889-1.68)	**1.35** (0.975-1.98)	**1.54** (1.04-2.28)	**1.81** (1.18-2.78)	**2.05** (1.30-3.21)
6-hr	**0.306** (0.240-0.389)	**0.372** (0.291-0.473)	**0.478** (0.374-0.611)	**0.567** (0.441-0.728)	**0.689** (0.521-0.935)	**0.779** (0.578-1.09)	**0.877** (0.636-1.28)	**0.999** (0.677-1.48)	**1.19** (0.774-1.82)	**1.35** (0.861-2.12)
12-hr	**0.187** (0.148-0.237)	**0.230** (0.182-0.291)	**0.300** (0.236-0.381)	**0.358** (0.280-0.457)	**0.438** (0.333-0.592)	**0.497** (0.371-0.690)	**0.562** (0.410-0.818)	**0.642** (0.437-0.945)	**0.768** (0.502-1.17)	**0.877** (0.561-1.37)
24-hr	**0.110** (0.087-0.138)	**0.138** (0.109-0.173)	**0.183** (0.145-0.231)	**0.221** (0.174-0.280)	**0.273** (0.209-0.367)	**0.310** (0.234-0.431)	**0.353** (0.260-0.515)	**0.407** (0.278-0.597)	**0.494** (0.324-0.753)	**0.571** (0.367-0.889)
2-day	**0.061** (0.049-0.076)	**0.079** (0.063-0.098)	**0.107** (0.085-0.134)	**0.130** (0.103-0.164)	**0.162** (0.125-0.219)	**0.185** (0.141-0.258)	**0.212** (0.158-0.312)	**0.248** (0.169-0.362)	**0.307** (0.202-0.467)	**0.361** (0.233-0.560)
3-day	**0.044** (0.036-0.055)	**0.057** (0.046-0.071)	**0.078** (0.062-0.097)	**0.095** (0.076-0.119)	**0.119** (0.092-0.159)	**0.136** (0.104-0.188)	**0.155** (0.117-0.228)	**0.182** (0.125-0.265)	**0.227** (0.150-0.344)	**0.268** (0.173-0.414)
4-day	**0.036** (0.029-0.044)	**0.046** (0.037-0.057)	**0.062** (0.050-0.078)	**0.076** (0.061-0.095)	**0.095** (0.074-0.127)	**0.109** (0.083-0.150)	**0.124** (0.094-0.182)	**0.145** (0.100-0.212)	**0.181** (0.120-0.275)	**0.214** (0.138-0.331)
7-day	**0.024** (0.020-0.030)	**0.031** (0.025-0.038)	**0.041** (0.033-0.051)	**0.050** (0.040-0.062)	**0.062** (0.049-0.083)	**0.071** (0.054-0.097)	**0.081** (0.061-0.118)	**0.094** (0.065-0.137)	**0.116** (0.077-0.176)	**0.136** (0.088-0.210)
10-day	**0.020** (0.016-0.024)	**0.025** (0.020-0.030)	**0.032** (0.026-0.040)	**0.039** (0.031-0.048)	**0.048** (0.037-0.063)	**0.054** (0.042-0.074)	**0.061** (0.046-0.089)	**0.071** (0.049-0.103)	**0.087** (0.058-0.131)	**0.101** (0.065-0.155)
20-day	**0.014** (0.012-0.017)	**0.017** (0.014-0.021)	**0.021** (0.017-0.026)	**0.024** (0.020-0.030)	**0.029** (0.023-0.038)	**0.032** (0.025-0.044)	**0.036** (0.027-0.051)	**0.041** (0.028-0.059)	**0.048** (0.032-0.072)	**0.055** (0.035-0.084)
30-day	**0.012** (0.010-0.015)	**0.014** (0.011-0.017)	**0.016** (0.014-0.020)	**0.019** (0.015-0.023)	**0.022** (0.017-0.028)	**0.024** (0.019-0.032)	**0.027** (0.020-0.037)	**0.030** (0.021-0.043)	**0.034** (0.023-0.051)	**0.038** (0.025-0.058)
45-day	**0.010** (0.008-0.012)	**0.011** (0.009-0.014)	**0.013** (0.011-0.016)	**0.015** (0.012-0.018)	**0.017** (0.013-0.022)	**0.019** (0.014-0.024)	**0.020** (0.015-0.028)	**0.022** (0.016-0.032)	**0.025** (0.017-0.037)	**0.027** (0.017-0.041)
60-day	**0.009** (0.007-0.011)	**0.010** (0.008-0.012)	**0.011** (0.009-0.014)	**0.012** (0.010-0.015)	**0.014** (0.011-0.018)	**0.015** (0.012-0.020)	**0.017** (0.012-0.023)	**0.018** (0.013-0.026)	**0.020** (0.013-0.029)	**0.021** (0.014-0.032)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

APPENDIX E

Operation and Maintenance

USJ O'Connell Athletic Center
West Hartford, CT

Regular inspection and maintenance of the stormwater management system and uphill areas is necessary to ensure proper operation. Inspections of the stormwater management system and pavement areas should be conducted monthly based on the following table:

Site Areas:

Inspection and Maintenance

Check for:	***Corrective Measure:***
Erosion	Install erosion control measures and provide stabilization measures
Spillage	Contain spill as close to source as possible with a dike of absorbent materials installed to protect drainage inlets, stormwater areas, or downstream wetlands and streams. All hazardous waste material, including absorbent materials must be disposed of by a licensed hazardous waste transporter and disposed of in an environmentally acceptable manner
Sediment Accumulation	Stabilize any disturbed areas uphill of where the sedimentation is occurring. Use temporary erosion control measures (i.e. silt fence, straw bales) to filter stormwater runoff.
Trash	Pick up and dispose of trash and litter in an environmentally acceptable manner.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***
Pavement Sweeping	Minimum two times per year: during spring cleanup (after last snow event) and during fall cleanup (to remove fallen leaves)
Pavement De-icing	Apply anti-icing treatment prior to storms Apply deicing treatments as needed during and after snow storms and mixed precipitation events to control ice and compact snow not removed during plowing

Catch Basins and Pipe:

Inspection and Maintenance

Check for:	***Corrective Measure:***
Trash, Sediment, and Debris at Grate	Remove trash, sediment, and debris and dispose of in an environmentally acceptable manner.
Sediment & Trash Accumulation in Sump	Remove sediment from sumps if depth of deposits is greater than one-half the depth from the bottom of the catch basin to the invert of the lowest pipe in the basin.
Pipe blockages	Flush pipes to remove blockages. TV inspect as required.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***
Sediment Removal	Minimum one time per year: Remove sediment and trash from catch basin sumps and grates and pipe inverts. Dispose of sediment and trash in an environmentally acceptable manner.

USJ O'Connell Athletic Center
West Hartford, CT

Infiltration System

Inspection and Maintenance

Check for:	***Corrective Measure:***
Sediment Accumulation	Remove sediment when accumulation exceeds 3 inches throughout the length of the row per manufacturer's specifications.
Trash and Debris	Remove trash and debris and dispose of in an environmentally acceptable manner.

At a minimum the following maintenance measures shall be provided at the frequency listed in the following table:

Routine Maintenance

Maintenance Measure:	***Frequency:***
Sediment Removal	Inspected a minimum immediately after completion of the site's construction, every 6 months for the first year of operation and annually after the end of the first year. Remove sediment accumulation as required. Dispose of sediment in an environmentally acceptable manner.
Trash and Debris	Minimum once per year.

The infiltration system is to be inspected and maintained per manufacturer's specifications. Product information is attached.

USJ O'Connell Athletic Center
West Hartford, CT

STORMWATER MANAGEMENT SYSTEM INSPECTION AND MAINTENANCE CHECKLIST

USJ O'Connell Athletic Center Date: Date Since Last Precipitation Event:	Time:	Inspector: Site Conditions:

Inspection Item	**Satisfactory? Yes (Y) or No (N)**		**Comments or Corrective Measures Taken**
Site Areas			
Erosion	Y	N	
Spillage	Y	N	
Sediment Accumulation	Y	N	
Trash	Y	N	
Catch Basins and Pipe			
Trash, Sediment, and Debris at Inlet Grates	Y	N	
Sediment & Trash Accumulation in Sump	Y	N	
Pipe blockages	Y	N	
Infiltration System			
Sediment Accumulation	Y	N	
Trash and Debris	Y	N	

OPERATIONS AND MAINTENANCE GUIDELINES

CDS Stormwater Treatment Unit

INTRODUCTION

The CDS unit is an important and effective component of your storm water management program and proper operation and maintenance of the unit are essential to demonstrate your compliance with local, state and federal water pollution control requirements.

The CDS technology features a patented non-blocking, indirect screening technique developed in Australia to treat water runoff. The unit is highly effective in the capture of suspended solids, fine sands and larger particles. Because of its non-blocking screening capacity, the CDS unit is un-matched in its ability to capture and retain gross pollutants such as trash and debris. In short, CDS units capture a very wide range of organic and in-organic solids and pollutants that typically result in tons of captured solids each year such as: Total suspended solids (TSS) and other sedimentitious materials, oil and greases, trash, and other debris (including floatables, neutrally buoyant, and negatively buoyant debris). These pollutants will be captured even under very high flow rate conditions.

CDS units are equipped with conventional oil baffles to capture and retain oil and grease. Laboratory evaluations show that the CDS units are capable of capturing up to 70% of the free oil and grease from storm water. CDS units can also accommodate the addition of oil sorbents within their separation chambers. The addition of the oil sorbents can ensure the permanent removal of 80% to 90% of the free oil and grease from the storm water runoff.

OPERATIONS

The CDS unit is a non-mechanical self-operating system and will function any time there is flow in the storm drainage system. The unit will continue to effectively capture pollutants in flows up to the design capacity even during extreme rainfall events when the design capacity may be exceeded. Pollutants captured in the CDS unit's separation chamber and sump will be retained even when the units design capacity is exceeded.

CDS UNIT INSPECTION

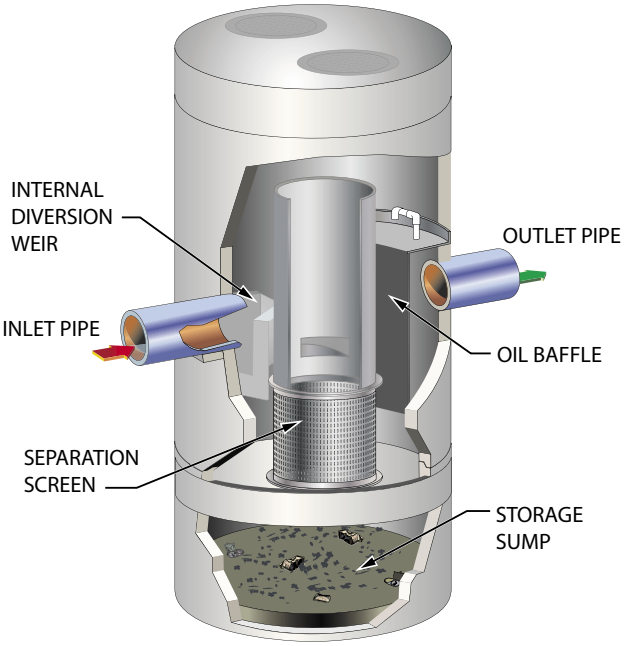
Access to the CDS unit is typically achieved through two manhole access covers – one allows inspection (and cleanout) of the separation chamber (screen/cylinder) & sump and another allows inspection (and cleanout) of sediment captured and retained behind the screen.

The unit should be periodically inspected to determine the amount of accumulated pollutants and to ensure that the cleanout frequency is adequate to handle the predicted pollutant load being processed by the CDS unit. The unit should be periodically inspected for indications of vector infestation, as well. The recommended cleanout of

CDS®

Patented continuous deflection separation (CDS) technology

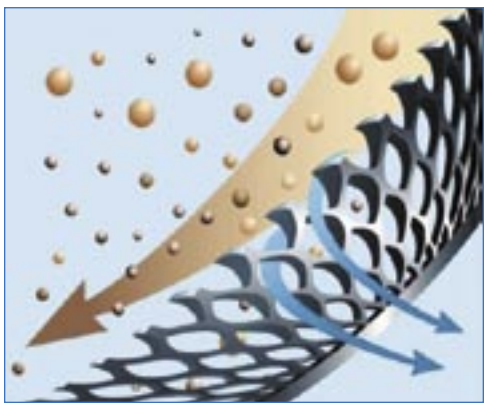
Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs. The pollutant removal capability of the CDS system has been proven in the lab and field.



How does it work?

Stormwater enters the CDS unit's diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed. All flows up to the system's treatment design capacity enter the separation chamber.

Swirl concentration and screen deflection forces floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.



Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During flow events exceeding the design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants will not wash out.

CDS

- Removes sediment, trash, and free oil and grease
- Patented screening technology captures and retains 100% of floatables, including neutrally buoyant and all other material greater than the screen aperture
- Operation independent of flow
- Performance verified through lab and field testing
- Unobstructed maintenance access
- Customizable/flexible design and multiple configurations available
- Separates and confines pollutants from outlet flow
- Grate inlet available
- Multiple screen aperture sizes available

Available Models

Refer to the following tables for our standard models, sizes, and treatment capacities. Drawings and specifications are available at contechstormwater.com.

We encourage you to contact your local stormwater consultant for site-specific design assistance. In many cases our products can be customized to fit your particular project's needs.

Local regulations may impact design requirements.

	CDS Model	Structure Diameter[1]		Typical Depth Below Invert		Water Quality Flow[2] 125 μm		Screen Diameter/Height		Sump Storage	
		ft	m	ft	m	cfs	L/s	ft	m	yd^3	m^3
Inline	PMIU20_15	4	1.2	3.7	1.1	0.7	19.8	2.0/1.5	0.6/0.5	0.5	0.4
	PMIU20_15_4	4	1.2	3.5	1.1	0.7	19.8	2.0/1.5	0.6/0.5	0.5	0.4
	PMSU20_15	5	1.5	4.4	1.3	0.7	19.8	2.0/1.5	0.6/0.5	1.1	0.8
	PMSU20_20	5	1.5	5.0	1.5	1.1	31.1	2.0/2.0	0.6/0.6	1.1	0.8
	PMSU20_25	5	1.5	5.3	1.6	1.6	45.3	2.0/2.5	0.6/0.8	1.1	0.8
	PMSU30_20	6	1.8	5.5	1.7	2.0	56.6	3.0/2.0	0.9/0.6	2.1	1.6
	PMSU30_30	6	1.8	6.5	2.0	3.0	85.0	3.0/3.0	0.9/0.9	2.1	1.6
	PMSU40_30	8	2.4	7.8	2.4	4.5	127.4	4.0/3.0	1.2/0.9	5.6	4.3
	PMSU40_40	8	2.4	8.8	2.7	6.0	169.9	4.0/4.0	1.2/1.2	5.6	4.3
Offline	PSWC30_20	6	1.8	5.3	1.6	2.0	56.6	3.0/2.0	0.9/0.6	1.9	1.5
	PSW30_30	varies	varies	6.3	1.9	3.0	85.0	3.0/3.0	0.9/0.9	5.8	4.4
	PSWC30_30	6	1.8	6.3	1.9	3.0	85.0	3.0/3.0	0.9/0.9	2.1	1.6
	PSWC40_30	7	2.1	7.7	2.3	4.5	127.4	4.0/3.0	1.2/0.9	1.9	1.5
	PSWC40_40	7	2.1	8.8	2.7	6.0	169.9	4.0/4.0	1.2/1.2	1.9	1.5
	PSW50_42	varies	varies	8.8	2.7	9.0	254.9	5.0/4.2	1.5/1.3	1.9	1.5
	PSWC56_40	8	2.4	8.8	2.7	9.0	254.9	5.6/4.0	1.7/1.2	1.9	1.5
	PSW50_50	varies	varies	9.5	2.9	11.0	311.5	5.0/5.0	1.5/1.5	1.9	1.5
	PSWC56_53	8	2.4	10.1	3.1	14.0	396.4	5.6/5.3	1.7/1.6	1.9	1.5
	PSWC56_68	8	2.4	11.8	3.6	19.0	538.0	5.6/6.8	1.7/2.1	1.9	1.5
	PSWC56_78	8	2.4	12.8	3.9	25.0	707.9	5.6/7.8	1.7/2.4	1.9	1.5
	PSW70_70	varies	varies	13.0	4.0	26.0	736.2	7.0/7.0	2.1/2.1	3.9	3.0
	PSW100_60	varies	varies	11.0	3.4	30.0	849.5	10.0/6.0	3.0/1.8	6.9	5.3
	PSW100_80	varies	varies	13.0	4.0	50.0	1415.8	10.0/8.0	3.0/2.4	6.9	5.3
	PSW100_100	varies	varies	15.0	4.6	64.0	1812.3	10.0/10.0	3.0/3.0	6.9	5.3

1. Structure diameter represents the standard inside dimension of the concrete structure. Offline systems will require additional concrete diversion components.
2. Water Quality Flow is based on 80% removal of a particle size distribution with an average particle size of 125 microns. This flow also represents the maximum flow prior to which bypass occurs. Test results are based on use of a 2400 micron screen.

Cast-in-place system are available to treat higher flows. Check with your local representatives for specifications.

Notes:

Systems can be sized based on a water quality flow (e.g. 1 inch storm) or on a net annual basis depending on the local regulatory requirement.

When sizing based on a water quality storm, the required flow to be treated should be equal to or less than the listed water quality flow for the selected system. Systems sized based on a water quality storm are generally more conservatively sized.

Additional particle size distributions are available for sizing purposes upon request.

Depth below invert is measured to the inside bottom of the system. This depth can be adjusted to meet specific storage or maintenance requirements.

Contact our support staff for the most cost effective sizing for your area.